THE KENT INCORPORATED SOCIETY
FOR PROMOTING EXPERIMENTS IN
HORTICULTURE

ANNUAL REPORT

(THIRTEENTH YEAR)

I. GENERAL

EAST MALLING RESEARCH STATION

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This Supplement will be circulated free to Founder Members, at cost price on application to Fellows and Associates, and at a small profit to non-members.

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N. H. GRUBB, M.S.A. (Cornell).
J. AMOS, N.D.H. (Manager Recorder).
A. W. WITT, N.D.H. (Propagator and Recorder),
H. M. TYDEMAN (Assistant and Meteorological Recorder).
Miss A. D. MACKENZIE, Dip. Hort. Sci. (Oxford and Reading). (In charge of records.)
A. C. PAINTER (Assistant Recorder).
Miss G. M. BLINKHORN (Assistant Recorder).
Miss M. GILLMAN (Hort. Dip., Swanley), (Assistant Recorder).

Plant Physiology : R. C. KNIGHT, D.Sc. (Lond.), D.I.C. of the Imperial College of Science and Technology.

Pathology : H. WORMALD, D.Sc. (Lond.), A.R.C.Sc., D.I.C.
R. V. HARRIS, B.Sc. (Lond.), A.R.C.Sc. (Special Assistant).

Entomology : A. M. MASSEE, F.E.S.
R. H. LE PELLEY, B.Sc., A.R.C.Sc., D.I.C. (Special Assistant).

Guide Demonstrator and Exhibitions Officer : H. C. CHAPELOW.

Laboratory Assistants : C. CORNFORD, Miss I. D. SKINNER.

Horticultural Advisory Officer to Kent County Council stationed at East Malling : N. B. BAGENAL, B.A. (Cantab.).

Secretary : Miss M. K. GLOVER, F.I.S.A.

Shorthand Typists : Miss M. B. HOAD, Miss E. M. SHEPHERD, Miss E. D. SIMONS.

Visiting Days : Tuesdays and Fridays, or by special appointment.
Hours : 10-12 a.m. 1-5 p.m.

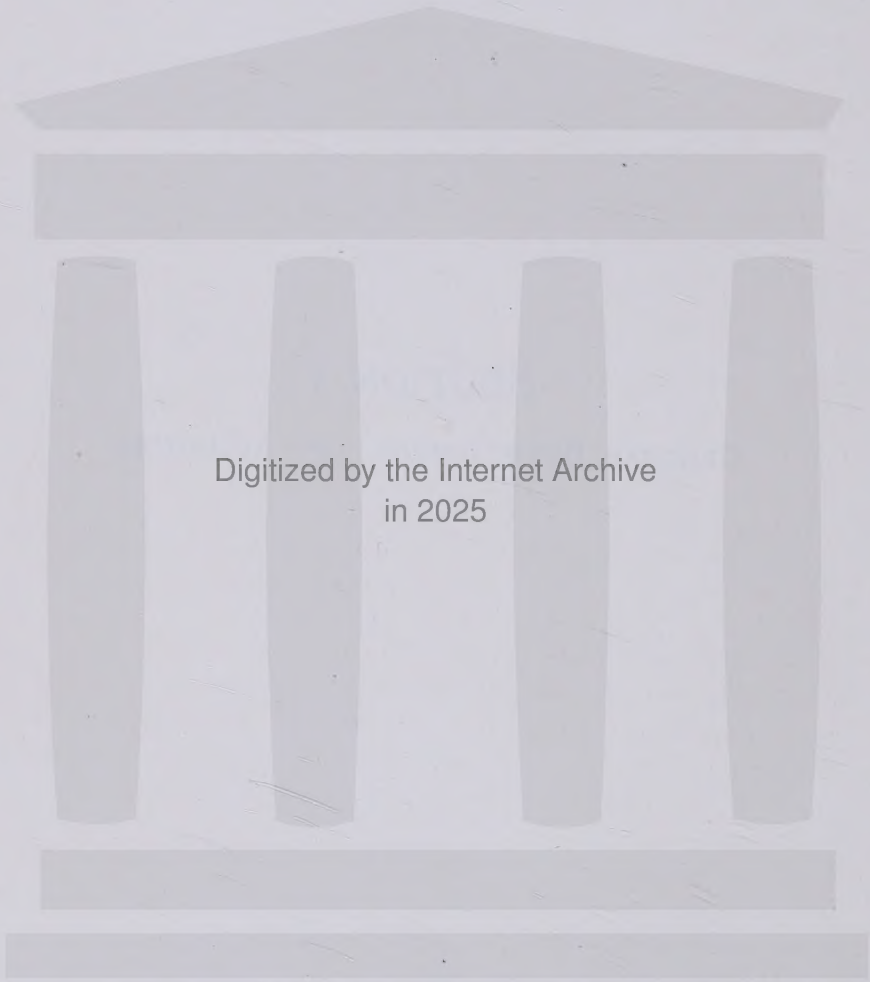
Passenger Station : East Malling Halt. *Goods :* Aylesford.

Bus Services from Maidstone every half-hour to East Malling Church.

Ditton Corner, on the main London to Maidstone Road, is the turning to the Research Station for visitors coming by car.

SECTION I

GENERAL DEVELOPMENT AND ACTIVITIES.



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Section I

GENERAL DEVELOPMENT AND ACTIVITIES.

The year 1925 has been characterised by a steady development in nearly every branch of the Station's activities. The most outstanding event of the year has been the receipt of a generous grant from the Hop Control of £10,000 to be applied to the development of the Station in general and of Hop Research in particular. It is to be hoped that this may encourage other bodies or industries, closely affected by our horticultural research, to follow suit.

In these times, it is only through such grants as these that the Station can hope to meet the evergrowing demands upon its services with full efficiency.

Committees.

The Committee of Management was re-elected for a further period of three years. The personel remains unchanged, with one exception; the H.T.A. has appointed as its representative Mr. W. R. Oldham, J.P. Mr. W. T. Colthup, owing to pressure of engagements, resigned from the Executive Committee, whilst still, we are glad to say, remaining a member of the Committee of Management. We are glad to welcome Mr. T. T. Harlow to the vacancy on the Executive.

The Executive Committee has held four quarterly meetings, and its sub-committees a further four. Amongst the particular items, besides general finance, which have been dealt with, are: acquisition of land; erection of Director's House; the temporary investment and provisional allocation of the grant from the Hop Control; subsequent consideration of plans for general development of land and buildings; the formulation of a scheme for regularising membership of the Society; the position of the Station with regard to membership of the English Hop Growers Ltd., and, finally, the Ministry's memorandum on the patenting of inventions.

The Hop Committee met once during the year to receive Professor Salmon's further report upon the widespread occurrence of downy mildew, and its apparently indigenous character.

The fifth Ordinary General Meeting of the Society was held on March 23rd, and considered and approved the Annual Report and Balance Sheet.

Finance.

For the past academic year the maintenance grants received from the Ministry of Agriculture have totalled £7,118 8s. 3d., this figure, besides including normal bonus on salaries and superannuation payments, comprises several

special grants for such items as our Raspberry Disease Investigations, a Burroughs Adding Machine, and contributions towards expenses at Wembley and the Imperial Fruit Show.

Both the Kent and East Sussex County Councils have continued to make their respective contributions.

It is satisfactory to note that the sales of produce for the year amounted to nearly £800 more than in the previous year.

With regard to capital funds, the chief event of the year is the gift of £10,000 from the Hop Control. This was allocated to the Station " with the concurrence of all parties concerned, and with the sanction of the Ministry of Agriculture," to be used " for one or all of the following purposes : The completion of the building scheme at the Station ; the purchase of land to provide further facilities for hop research ; investment in Trustee securities, and the application of the income arising to hop research."

Annual contributions from growers to the Capital Fund have been well maintained during the year, and the Committee has been considering the formulation of a scheme for regularising associate membership of the Society, by fixing definite subscriptions with certain privileges.

Building Scheme.

Plans for the erection of a Director's house, submitted by Messrs. Baillie Scott & Beresford, were approved in June, and the lowest tender was accepted. Since the necessary money was forthcoming, operations were started in the early autumn, and the roof was on by Christmas.

With regard to the extension of laboratory and administrative accommodation, the urgency of which was stressed in our last report, the conditions of the special grant from the Hop Control made it possible for the Committee to allocate provisionally a definite sum, £5,000, to that purpose, and Messrs. Forsyth and Maule have been invited to prepare plans. It is hoped that actual building operations will begin early in the New Year, since the congestion in the present buildings is daily becoming worse.

Land.

Unfortunately the situation described in our last report has in no way been relieved. A portion of the special grant (at least £2,000) was allocated by the Committee for the purchase of land on which to develop our hop experiments. Although various efforts were made during the year to acquire a suitable area which must be within easy reach of our laboratories, no really satisfactory proposition was offered. Since the acquisition of new land is a matter of the greatest urgency to the normal development of the Station, every effort is being continued to secure a suitable adjacent plot.

STAFF.

We are glad to be able to chronicle no changes in the senior members of Staff during the year.

As usual there has been considerable change in the recording staff of the Pomology section.

Mr. W. F. Cheal, N.D.A., D.I.C., who helped us over the winter's recording, left to take up a permanent post at the Kirton Farm Institute. Mr. W. Fowle (Hort. Dip. Wye) came back to us temporarily from February to June to share in the pruning and spring recording, before taking up a farm in West Sussex. We wish them both every success in their new work.

Mr. A. C. Painter came to us as a volunteer in June, and was offered a position on the recording staff in October. He is especially associating himself with the recording of crops from the experimental plots, and with their subsequent grading, storing, packing and marketing. This work is now becoming heavy enough to demand practically the full time attention of a marketing officer, in which capacity we hope to retain Mr. Painter's services.

Until the Autumn, we were assisted in our recording work by several of the advanced students referred to elsewhere in this report. To them, and especially to the untiring and loyal efforts of Mr. Gunnar Callmar, we owe our best thanks.

In September, Miss G. M. Blinkhorn and Miss M. Gillman (Hort. Dip. Swanley) joined the recording staff.

Once again it is necessary to point out that the frequent change in our recording staff is a matter for regret, however, we must congratulate ourselves that we have not had more changes. A recorder, in the probationary stages, can help us through the more or less mechanical measurings, weighings, etc., but it is only as he gets accustomed to our methods and plots that his individual initiative in recording can come into play.

Since we anticipated losing Mr. H. M. Tydeman, whom we congratulate on getting a half scholarship to Wye College, during the Autumn, Mr. H. C. Chapelow agreed to take over the responsibility for the Meteorological Recording. He attended a Special Course and Conference on the subject. We are glad to say that Mr. Tydeman is still with us.

During the Long Vacation at Cambridge, Mr. T. N. Hoblyn (Hort. Dip. Wye), returned to us and made a beginning of subjecting some of our figures to statistical analysis, but it will be another year yet before we can hope to have his full time services. In this connection, our special thanks are due to Dr. G. N. Yule, F.R.S., of Cambridge, for visiting the Station and giving us his advice.

In the Pathological work, Dr. Wormald has again had the assistance of Mr. R. V. Harris, B.Sc., A.R.C.Sc., who is working on Raspberry Diseases under

a special temporary grant from the Ministry of Agriculture. Mr. Harris has not only made considerable progress in the elucidation of the problems bearing on diseases in raspberries, but has also identified himself with the general activities of the department, and has helped in an advisory capacity particularly with reference to the diseases he is studying.

These raspberry problems are proving to be of considerable economic importance, and the investigation should yield valuable results if the work can be continued. It is desirable therefore (as pointed out in last year's report) that Mr. Harris' position on the Staff should be made a permanent one to ensure this continuity of the investigation.

Mr. W. F. Cheal worked for some time on hop diseases (Grey Mould and Canker) in the Pathological Laboratory, prior to taking up his new post.

In October, Miss A. M. Frampton, B.Sc., came as a voluntary worker in Pathology and has taken up the study of certain problems which previously could not be included in the programme of work.

The appointment of Mr. C. Cornford as full time laboratory assistant is helping to lighten the routine work of this department. This was made possible by the arrangement under which Miss I. D. Skinner is giving the Physiological Laboratory full time services, as is mentioned elsewhere.

Mr. R. H. Le Pelley, B.Sc., A.R.C.S., D.I.C., who came to us as a volunteer worker in the Entomology section in December, 1924, has remained with us throughout 1925. On July 1st he was appointed as a temporary Special Assistant to Mr. Massee. He is specialising on the Woolly Aphis investigations referred to elsewhere, and he has given general assistance to the Entomological work in other directions.

Social Activities of Staff.

Before October, 1925, all social activities such as games, excursions, etc., had been organised by an unofficial entertainments committee, or by individual members of Staff.

On September 29th, at a general meeting of members of Staff, a Social and Athletic Club was inaugurated, and an Executive Committee, representative of the interests of the inside and outside Staff, was elected. This Committee is now responsible for the organisation of all social and athletic functions connected with the Research Station.

Through the kindness of the Governing Body, a hard tennis court, recently laid down, has been placed at the disposal of the Club. Owing to limited accommodation, the Club is at present obliged to restrict the privilege of ordinary membership to all those actually working at the Research Station. The Club has already seventy members.

STAFF MEETINGS.

In the course of the year nine Staff Meetings for the presentation of papers have been held, in addition to several meetings for general discussions. The interest in the meetings is maintained, and with the increase in staff, the attendance now averages twenty. The programme for the current Session (December, 1925-March, 1926) includes papers by Dr. F. Kidd (Cambridge), Professor V. H. Blackman, F.R.S. (Imperial College) and Mr. N. T. Hoblyn (Cambridge), and contributions are being made by ten members of Staff.

In addition to these meetings, the experiment is being tried of holding short regular meetings for the discussion of general questions affecting the work of the Station.

COLLABORATION.

(*a*) Dr. R. C. Knight, D.I.C., of the Research Institute of Plant Physiology, Imperial College of Science, has been with us throughout the year and continued to share in all the Station's activities. In order to facilitate his work, arrangements were made for him to have call upon the full time services of a laboratory assistant.

The expected collaboration of a Bio-Chemist has been unfortunately deferred through the worker in question taking up an overseas appointment. It is still hoped that a suitable man may be forthcoming.

(*b*) *Hop Investigations.*

Professor E. S. Salmon, F.L.S., and Mr. A. H. Burgess, B.Sc., of the S.E.A. College, Wye, are keeping up their association with the testing of new varieties and the necessary chemical analyses. Our thanks are also due to Mr. Burgess for giving his advice upon the chemical aspect of the manurial trials, and to Mr. F. C. Arnaud, F.I.C., County Analyst, for again analysing the manures.

During the year Professor Salmon published his Eighth Report upon the data jointly collected.

(*c*) *Silver Leaf Investigations.*

The Silver Leaf investigations, in which Mr. F. T. Brooks, M.A., of the School of Botany, Cambridge, has for so long taken an active share, have been continued ; certain aspects of the work have already been reported upon by him, and others have sufficiently developed to warrant an early joint report.

(*d*) *Field Trials with Tar Distillate and other Winter Washes.*

This work has continued to develop along two lines. The field and laboratory trials, in collaboration with Dr. Wm. Goodwin, of the Chemical Department, S.E.A. College, Wye, of certain proprietary Tar Distillates and standard preparations, have been continued with interesting results. The testing of 3:5 dinitro-o-cresols and other chemical preparations in the field, in conjunction with Mr. F. Tattersfield, B.Sc., F.I.C., and Mr. C. T. Gimingham, F.I.C., of the Department

of Insecticides and Fungicides, Rothamsted Experiment Station, Harpenden, has already yielded results striking enough to warrant the preparation of a joint report. Collaboration is continuing in both these directions.

(*e*) *Breeding New Root-stocks.*

Maiden trees worked on the first series of apple stocks raised by Mr. M. B. Crane, of the John Innes Horticultural Institute, Merton, as a result of crossing Doucin (Type II.) with French (Type VIII.), are already in existence.

The other side of the work, the attempt at producing stocks immune to Woolly Aphis, has been accelerated by the temporary appointment of a special worker to deal with the entomological aspect.

(*f*) *General Collaboration.*

A joint meeting with the Long Ashton Staff was held on October 12th and 13th, to discuss the existing memorandum on co-operation, (mentioned in the Annual Report of this Station, 1922), and see how far it could be applied under the considerably altered circumstances. A mutually satisfactory interpretation of this document was arrived at, and, in the light of this agreement, the Research Programmes of the two Staffs were jointly discussed, with a view to seeing where collaboration or duplication of effort would be advantageous, or, on the other hand, where overlapping could be avoided. In a number of instances agreements were reached between the members of staff actually concerned. Questions of the publication of such collaborated work were also discussed. It has been agreed to hold an annual joint meeting of the two Staffs.

Outside Trials.

As has been mentioned in our previous reports, we are still keeping under direct observation and manipulation a number of trees on known root stocks, and named varieties of bush fruits, which we established through the courtesy of various Institutions and Growers upon different soils. Many of these plots bore their first considerable crop of fruit during 1925, so that we were particularly anxious to secure the data. In most cases this was successfully carried through, though at the cost of considerable time and trouble. Some twenty days were spent on these plots by three recorders, which is the equivalent to the full time of one person for sixty days. In addition, Mr. Bagenal gave assistance on two occasions on plots in Kent.

It is, however, felt that the study of the suitability of root stocks and varieties to different soil and climatic conditions is of such vital importance as to justify this expenditure of time.

When our full results are published they will be of far wider application than if our observations were confined to our own conditions alone.

Apart from these trials with our own raised and planted material, Mr. Grubb is conducting a Pruning Experiment with the kind consent of

Mr. L. Morford, Parsonage Farm, Brenchley. Mr. Bagenal has co-operated with him in this work.

In three instances, the Pathological Department have been following up control measures or making observations on the cause of diseases on commercial farms.

ADVISORY WORK.

(*a*) *Correspondence.*

Though, as pointed out in last year's Annual Report, we are not constituted an Advisory Centre, and receive no assistance on this account, our work under this heading has again increased. Apart from the 98 letters dealt with by the County Horticultural Advisor, of which 66 came to him directly or indirectly through the Research Station, our own Staff have dealt with 870 enquiries by letter, an increase of 110 on the previous year. These may be classified as follows :—

Pomology.		
Small Fruits (mainly Blackcurrants and Raspberries)	125	
Fruit Tree Stocks	170	
Propagation	61	
Planning and planting (in relation to soils, varieties, etc.)	57	
Spraying	31	
Pruning	28	
Miscellaneous	179	
Total		651
Pathology.		
Raspberry Diseases	20	
" Die-back " in fruit trees	18	
Spraying	12	
Hop Wilt	8	
Brown Rot	8	
Silver Leaf	6	
Apple Scab	5	
Crown-gall and Burr-knot	3	
Quince leaf spot (in relation to nursery stocks)	2	
Miscellaneous	34	
Total		116
Entomology.		
Big Bud	17	
Red Spider (control)	14	
Coleoptera (mainly weevils)	13	
Hemiptera (aphids and capsids)	13	
Insecticides (use of)	13	
Miscellaneous	33	
Total		103
Grand Total		870

It will be seen from the above summary that the great majority of enquiries received dealt more or less directly with subjects being investigated at the Station. However, under the heading " Miscellaneous," there are 246 enquiries on general subjects. These enquiries were replied to for various reasons. In the first place many came from our members and supporters ; others related to subjects not to our knowledge under particular investigation at any Research Station, whilst the replies to others again were so obvious that the natural course was a direct answer. It is suggested that, as this activity constantly increases the call upon the time of members of the *Research* Staff, in future, it may be necessary to give preference to letters coming from our members, or from Counties which make a contribution to our funds.

As in 1924, considerably over half our enquiries came from Kent and other Counties in the South East. The following analysis shows this. The remainder here shown were fairly widely distributed, most English Counties, as well as Scotland and Ireland, being represented.

Source.	*No. of Enquiries.*
Kent	*305
Sussex	90
Hants.	40
Surrey	39
Herts.	26
Beds.	23
Middlesex	15
Essex	13
Berks., Bucks., Oxon.	23
Rest of British Isles	265
Abroad	31
Total	870

* (98, Answered by County Hort. Advisor not included).

Calls for advice over the telephone have also increased. Although no complete record has been kept, it is known that the total number was between 200 and 300.

As usual, very many of the written enquiries have been accompanied by specimens for identification, and during the year, nearly 40 living specimens have been planted in the indentification plot for observation.

(*b*) *Visits.*

Of visits to growers on their farms, paid by individual members of the Research Staff, 160 have been recorded ; this is a big increase upon last year. More than three-quarters of these were to growers in Kent and Sussex. These

visits were not by any means confined to the Pomological Staff, Entomology accounting for 36, and Pathology for 30.

The Kent County Horticultural Advisor reports his having paid 138 visits to growers, many of whom had applied direct to us for advice. In reckoning the total number of growers visited, it must be borne in mind that on not a few occasions more than one member of Staff went in consultation.

During the year, two short tours were carried out. One with Mr. T. Wallace, of Long Ashton, related chiefly to soils in Kent and Sussex ; the second included visits to some of our grower friends in Devonshire.

We have continued to try to keep in touch with our local growers through the monthly " Notes " edited by Mr. Bagenal and special articles contributed by various members of Staff in the Journal of the Kent Farmers' Union.

LECTURES, DEMONSTRATIONS AND CONFERENCES.

(*a*) *Lectures.*

Without doubt the organised courses of lectures given by Mr. Bagenal satisfied a much felt want ; and, in doing so, have relieved the Research Staff of practically the whole of the demands on their time from Kentish Farmers' Clubs and N.F.U. Branches. He reports having given forty-two lectures; these included four short courses on Commercial Fruit Growing, dealing mainly with the work already done at the Station on Stocks, Pruning, Black Currants and Raspberries.

Members of the Research Staff have given twelve special lectures during the year, six each from the Pomological and Entomological Staff. These were mainly to conferences or societies which would not come within the normal sphere of a County Advisor.

(*b*) *Demonstrations.*

In addition to these lecture, both outdoor and indoor demonstrations have been given. Following on the successful experiments last year, two pruning demonstrations, in East and West Kent respectively, were given in addition to the one at the Station. On February 5th, one hundred growers and others attended a combined pruning and spraying demonstration on the farm of Mr. H. F. Ash, Woodnesborough, near Sandwich. On November 20th, a demonstration was arranged at the Station ; in spite of most unpropitious weather, some twenty or more growers attended. A third demonstration was given on December 16th, at Mr. A. T. Miller's farm at Crockenhill ; some thirty-five growers and tree cutters attended. An encouraging feature of these demonstrations has been the number of growers who brought their tree cutters with them. In each case Mr. Bagenal made the detailed arrangements and helped Mr. Grubb at the demonstrations. He reports having independently given six other demonstrations in various parts of Kent.

At the special request of the Committee of the Imperial Fruit Show, East Malling undertook to give daily pruning demonstrations in the hall during the show. Suitable trees were kindly supplied by Messrs. Seabrook. Unfortunately it was impossible to keep to the original arrangement, owing to the fact that the musical programme synchronized exactly with the demonstration. The latter was actually given each day from 5.30 to 7 p.m. and was attended, on a rough estimate, by an average of forty persons daily.

Mr. Witt estimates that he has given some thirty informal demonstrations in budding, grafting and layering to parties of visitors or individual enquirers.

(*c*) *Conferences, etc.*

In April a conference was held at Oxford under the auspices of the Ministry of Agriculture on The Theory of Experimental Error and its application in practice. A paper dealing with the horticultural aspect of the subject was prepared and delivered by the Director; and, since this subject was of such vital importance to our field experimentation here, four other members of Staff attended throughout the period. The one-day conference of Advisory Mycologists held at the same time and place was attended by two members of Staff who described their work on raspberry diseases.

Two or more members of Staff have attended the virus Diseases Committee of the Ministry of Agriculture on three occasions.

Three members of Staff were present at the Cherry Conference of the R.H.S., held at the Small Fruit Show on July 14th, two of whom were also acting as judges at the Small Fruit Show.

The Annual Conference of the Research, Advisory and Educational Horticulturists in the South-Eastern Province was held at Swanley College on June 9th. Several members of Staff attended, and joined in the discussions, besides demonstrating the results of the root stock work on the trial plot.

Miss A. D. MacKenzie read a paper on the Preservation of Specimen Fruits at the annual meeting of the British Association.

The Station has been represented on the Agricultural Research Council, the Horticultural Advisory Council, the Technical Committee of the Chamber of Horticulture; the Publications Committee of the Journal of Pomology. Several other special meetings dealing with Ministry's fruit testing scheme, meteorological observations, and proposed International Conference were attended by invitation.

EXHIBITS.

An invitation was again received from the Ministry of Agriculture to stage an exhibit in the Government Pavilion at the British Empire Exhibition at Wembley. Owing to the prohibitive cost, and limited amount of time at our

disposal, a fresh exhibit was not prepared and it was deemed advisable to repeat, in a slightly modified form, the Apple Root-Stock Exhibit shown the previous year.

The collection of specimen fruits preserved in glass jars by Miss MacKenzie for the Ministry of Agriculture, and stored by us, was also restaged at Wembley.

The Bath and West and Kent County Shows joined forces and held a single five day show at Maidstone, at which we staged a complete exhibit of our Black Currant and Raspberry researches. This exhibit was the largest ever staged by us, and also the most exhaustive. Help was rendered to Long Ashton in staging and caring for their exhibit. The early date of the Bath and West Show prevented the Committee of the Soft Fruit Show from holding that show at the same time.

This latter was therefore held in conjunction with the R.H.S. at one of its fortnightly meetings in July. At this we staged the portions of our Soft Fruit Exhibit dealing with different varieties.

The East Sussex Horticultural Sub-Committee invited us to stage an exhibit at their three days County Show, held at Lewes, immediately following the above. Here again we staged our whole Soft Fruit Exhibit, and, owing to the later date, we were able to present our Soft Fruit varieties in an even more complete form than was possible at the earlier Maidstone Show. The exhibit interested a large number of growers of small fruit, and a considerable amount of useful work was done. The County Committee subsequently wrote a letter of appreciation.

At the Imperial Fruit Show, held from October 30th, 1925 to November 11th, 1925, at Holland Park, the Station put an entirely new exhibit, giving the full details of our twelve years' work in Apple Pruning. Many visitors took the opportunity to study carefully the results presented.

In conjunction with this exhibit a daily Pruning Demonstration was given in the Hall.

At all the above shows, various members of Staff were in attendance from time to time in addition to the Exhibition's Officer.

Our exhibition activities have not been confined to shows at which members of Staff were personally present. In four cases we have received applications from County Organisers to loan exhibits for their County Shows. As time and money would not allow of our personal attendance, suitable self explanatory material was in each case selected from our complete exhibits for the purpose.

Finally it should be added that, during the year, many of our Exhibits dealing with special aspects of our work, have been thoroughly reorganised on the lines of "a story," and brought up to date. The pruning and soft fruit exhibits already referred to have been dealt with in this way, and also those dealing with the Apple and Plum Stock results. Brief explanations of these exhibits were printed as leaflets for the benefit of enquirers.

VISITORS.

The visitor's book records 840 persons as having been shown round the Station during this year. While this figure includes thirteen organised parties, one of about 150 and the others averaging about twenty visitors per party, some 450 persons called at the Station individually, and their visits were spread over 145 days. In all, visitors were received on 158 days in the year. Only rarely did it happen that the visits of two or more people could be made to coincide, and it was thus necessary for the guide to tour the Station on no fewer than 306 occasions, equivalent, excluding Sundays, to once a day throughout the year. The following table shows the details of these visits :—

Visitors—1925.

Month.	*No. of days on which visits were paid.*	*No. of visitors per month.*
January	10	22
February	7	45
March	12	21
April	14	18
May	11	34
June	19	147
July	15	238
August	18	82
September	23	134
October	12	35
November	10	49
December	7	14
Total	158	839

These figures show little change from last year's records, but it is interesting to note that, while visitors preponderate during the six pleasantest summer months, almost a quarter of the total number came during the six winter months.

Although the above table gives an approximate idea of the number of visitors received here, it is found impossible in practice actually to record the full numbers. This is due to the fact that not a few growers have now become so well acquainted with the place, that, without proceeding to the office, they go direct to the section of the farm or member of staff they wish to see.

Although probably fewer visitors from abroad were in this country in 1925 than during the first Wembley year, a considerable number of growers and research workers from overseas were received at the Station. These

included travellers from South Africa, Canada, New Zealand and Tasmania, The United States of America, Germany, Holland, Sweden, Denmark, Japan and China.

Towards the end of July, the Genetical Society, under the leadership of the late Professor W. Bateson, F.R.S., paid a visit to the Station. Considerable interest was aroused in the various lines of research work then in progress, and many valuable discussions ensued.

Early in September, a party of Dutch growers, under the guidance of the Federation of British Growers' Association, and Mr. B. Gerritzen, Horticultural Adviser to the Netherlands Legation, visited the Station. They subsequently wrote a most appreciative letter testifying to the international value of the experimental work.

In addition to the above, the following parties were received :—

The Tunbridge Wells Farmers' Club.
The Dartford Farmers' Club.
The Ash and District Growers' Association (Canterbury).
The Horticultural Sub-Committee of the East Sussex County Council.
The Ashford and District Teachers' Association.
The London School Gardening Association.
The Kent Federation of the Workers' Education Association.
The Mid-Kent Natural History and Philosophical Society.
The Rochester Naturalists' Club.

As in former years, Horticultural Students from Wye College and Swanley College have had a day or so of study at the Station.

The Station with its own staff provided teas for some 500 of these visitors, and light luncheons for some 150. In addition, two of the parties mentioned above were catered for at the Station by a Maidstone firm. Those who are familiar with the very inconvenient and limited arrangements at the Station will appreciate what this work here has entailed.

It will thus be seen that whilst the Station's main activities are on behalf of the commercial grower, it is also doing its duty by educational bodies, and is helping to interest the average taxpayer in the objects and application of horticultural Research.

Post-Graduate Students.

The present year has seen a further development in the Station's activities. No fewer than six advanced or post-graduate students have been here for longer or shorter periods, varying from one year to ten days.

Mr. H. D. Bennett came here for two months with a Ministry of Agriculture's Scholarship for Organisers, Teachers and Lecturers in Agriculture.

Mr. Gunnar Callmar was with us during the whole of 1925 on a special scholarship from the Swedish Government.

Mr. C. R. Gregory, of Kew, came to get acquainted with our fruit tree stock research, prior to taking up an appointment as Assistant Lecturer to the Warwickshire County Council.

Mr. T. Umpleby, of Long Ashton Research Station, was with us for two weeks studying our propagation methods.

Mr. H. L. White, a student from the Cheshunt Experiment Station, stayed with us for ten days gaining experience in our experimental methods.

Mr. S. Rogers, who was studying for his Horticultural Diploma at Cambridge came to us to collect material for his thesis.

Labelling the Plots.

The constant frequenting of the Station by growers, students and the general public has necessitated a very drastic revision and an intensive campaign of labelling our plots, in order to render them intelligible to the visitor. Very considerable progress has been made this year both in the actual work and in our method of doing it.

When it is realised that some of our experimental plots demand as many as 260 labels per acre, the extent of this work can be measured. Our plots were originally planned to secure the maximum of experimental efficiency rather than a good demonstrational effect, which fact naturally complicates such operations.

The labelling incidentally helps to accelerate the work of our field recording Staff.

Meteorological and Horticultural Observations.

All the instruments required by the Ministry's scheme were erected on the new sites and tested prior to January 1st, 1925. The special observation plot of trees and bushes was also planted in the winter of 1924-25, so that a full year's readings, and preliminary records, have been obtained.

It has been found that, even in its early stages, the work entailed is very considerable. The daily readings and entries occupy on the average fifty to sixty minutes, and the monthly reckonings of Dew Points, Vapour Pressures, Humidities, the summarising of daily diaries, etc., takes the best part of a week. This is a serious matter at busy seasons of the year, and it is much to be hoped that these calculations may in future be handled by the skilled computers of the Ministry or the Meteorological Office, rather than by our Staff here.

As a result of the keenness of members of Staff, the Station agreed to co-operate with the Ministry in making the Phenological Observations. This work is in the hands of a small Committee of six, each member of which is responsible for a certain number of the plants on the short list. This Committee

is entirely responsible for taking these records and presenting them in connected form.

In connection with the Ministry's Meteorological Scheme, it might be mentioned that this Station has furnished the comparable material for the Observation Plots at seven centres.

LIBRARY.

A range of periodicals, representative of the particular interests of all members of the Staff, is now available in the library, and in consequence it has been necessary to provide a range of pigeon-hole cases to ensure the accessibility of the current numbers. With the increase in the number of books, reprints and bulletins it has also become necessary to provide an additional bookcase. Several volumes have been purchased, and the Station is indebted to Mr. F. Kakebeeke, Göes, Holland, and Prof. U. P. Hedrick, Geneva, N.Y., for the presentation of books.

The work of classifying and cataloguing the library along the usual lines is well under way.

DISTRIBUTION OF STOCKS AND SMALL FRUITS TRUE TO NAME AND OF EXPERIMENTAL TREES.

As stated in our Annual Report for 1922, East Malling was asked by representatives of the Nursery Trade, as far back as 1918, to start distributing named specimens of classified stocks both for identification purposes and as a nucleus for establishing stool beds.

From 1922 up to the present time considerably over 100,000 have been distributed for these purposes, so that since 1918 something closely approaching 200,000 named root stocks have gone out all over the country for stool bed making, and the demand has been fairly consistent from year to year. From such a nucleus ample supplies should now be forthcoming.

It is felt therefore that, so far as the common varieties of stocks are concerned, East Malling has now fulfilled its duty and that, in future, its propagating activities will be confined mainly to the scarce varieties and to new introductions of its own.

The same point has been reached so far as the arrangement made at the request of the Ministry of Agriculture for the raising of trees of known history for experimental purposes is concerned. Since the winter 1922 East Malling has sent out—mainly in small consignments—approxiately 14,000 young Apples, Pears and Plums upon various root stocks for the conduct of root stock trials upon the Demonstration plots of County Councils and other Experimental Institutions. During that period about 270 such orders have been dealt with.

Since 1918 nearly 20,000 young trees have been distributed. These experimental trees have been widely distributed throughout the British Isles

and should yield extremely interesting information relative to stock effect under different conditions. In future, this raising of experimental trees will be discontinued, unless individual Institutions give special orders beforehand. All surplus trees raised from this experimental nursery have been offered to the Trade annually for tender.

Approximately 50,000 truly named Black Currants have also been distributed in comparatively small quantities for demonstration purposes and as a nucleus for further propagation. Since 1922 up to the present season (1925-26) these bushes have been distributed to forty-four demonstrational centres situated in twenty-three different counties. A considerable number of Raspberry Canes of known variety have also been distributed for similar purposes.

Both because a knowledge of the behaviour of individual varieties under different conditions of environment is of such paramount economic importance to growers, and because our methods of roguing and selection have led to the multiplication of numerous healthy and heavy cropping races of small fruits, it is proposed to continue this activity for a few more years.

A limited number of specimen stocks and varieties of small fruits have been sent for purposes of identification and experimentation to Research and Educational Institutions in the following countries :—Canada, South Africa, New South Wales, Tasmania, India, Egypt and Japan.

In Europe, samples have been sent to research workers in Belgium, Denmark, Germany, Holland, Norway, Sweden and Czecho-Slovakia. These plants have usually been sent by way of exchange for material required.

We are beginning to receive some very interesting reports as to the behaviour of our root stocks in various parts of the world.

When it is realised that East Malling was never organised for distribution work of this sort, and that these very varied orders, despatched under such diverse conditions, have entailed an immense amount of detailed work, both the Propagation Department and the Office Staff must be congratulated upon the way in which this effort has been carried through.

For several seasons now, fruit from apple trees of known history have been supplied to the research workers at Cambridge and the Imperial College, collaborating with the Committee of Scientific and Industrial Research.

In addition several well-known firms of jam and preserve makers have been supplied with fruits true to name for the purpose of testing relative values of different varieties.

Administrative Work.

A review of all the foregoing activities will show that the steady and consistent development along so many lines must bring additional calls upon the Administrative Staff. No changes or additions have taken place on this Staff

during the year. Not only is there an ever increasing inward and outward post bag, but the amount of time occupied at the telephone switchboard is now quite considerable. In addition, well over 1,000 bulletins and leaflets have been distributed through the Office during the year, and the Mailing Lists revised and brought up-to-date. The amount of typewriting and stencilling work has also increased in proportion to the activities of our Committees (involving the circulating of Minutes and other documents) and the output of reports by individual members of Staff. The amount of material contained in our last Annual Report is but one example.

All this work has been carried through under anything but satisfactory conditions owing to the general unsuitability of the present rooms which are used as temporary offices.

The Office Staff has also undertaken to give one half day a week to the arrangement and card-indexing of the growing Library. It is found difficult to spare even this amount of time, which is all too short for the purpose ; but, during the year, all books have been labelled and stamped and the card index commenced. A beginning was also made with the listing of Bulletins received from other Research centres.

Our Auditors, in drawing up the last Balance Sheet, commented on the very rapid increase in the amount of Book-keeping necessary. The attempt at keeping Farm Costings, in collaboration with Mr. Wyllie, Costings Officer, S.E.A. College, Wye, on certain of our larger plots, which are commercially planned and run, also involves additional handling of our accounts. However, it is felt that the results likely to be obtained will justify the extra work involved.

As is mentioned elsewhere, the reception and entertainment of visitors also adds very considerably to the work of the Administrative Staff.

It has been an exceptionally heavy year administratively and the work has been carried through with credit.

Section II

The Farm.

Section II

THE FARM.

The gross returns from the sale of farm produce during 1925 amounted to £3,630 16s. 6d., which, as is mentioned elsewhere, is £800 in excess of the previous year. This is due rather to the fact that many of our plots are now reaching maturity than to any exceptionally heavy crops in 1925.

We had by far the heaviest crop of Apples we have yet handled, and we were able to bring through a crop of good quality and market it more attractively.

Although the year was not a record one for Black Currants, still we had heavy allround yields, Baldwin once more returning to first place with a crop of well over 3 tons per acre.

Raspberries suffered considerably from drought with us and were only a moderate crop of moderate quality. Since our chief objective in the past has been cane production, fruit producing has taken a secondary place, but in the forthcoming year we are planting up a considerable acreage for fruiting purposes primarily.

Our considerable collection of Red Currants yielded their first small crop.

Both Plums and Pears looked very promising at blossoming time but proved equally disappointing later. Our young Nursery Trees made good growth for the year.

Six acres of land were again devoted to the elaboration of our methods of Corn Trial. Four varieties of Wheat and four of Winter Oats were grown.

The potato spraying trials upon British Queen have now reached their eighth year.

Different varieties of runner and broad beans were also grown. The former yielded heavily and did much better than the previous year.

The adverse weather in the early part of the year was unfavourable to the growth of the Hop, but during the latter part of the season conditions rapidly improved and heavy crops of good appearance resulted. The average yield per acre from our three acres of Tutshams were 26 cwt., and many of Prof. Salmon's Seedling Varieties gave correspondingly high yields.

Probably our worst pest during the year was Red Spider on Apples and Plums. The various Tar Distillate washes which we used more or less effectively against aphids were quite ineffective against this, and only where we had sprayed our Apples just before and after blossoming with Lime Sulphur against scab did we seem free of the pest. Although we fully expected a bad scab year, under our conditions it was very readily controlled by the usual fungicides. Last season the loss on Plum trees from Silver Leaf and " die-back " was much less than in

the previous year. The Gooseberry Saw-fly Caterpillar was very troublesome, and the Pear and Cherry Slug worm much in evidence. Downy Mildew was again in evidence on certain varieties of Hops.

The fruit planting programme last season was a very modest one. We added to our variety collection of Apples about half an acre of dessert varieties upon Metz (Type IX.) Stock. We also interplanted some three acres of Plum trees with Baldwin Black Currants for pruning trials and an acre of Apples with clone races of Black Currants to form a nucleus for propagation purposes. However, we raised in the nursery a considerable number of feathered and half standard experimental trees for planting out in the 1925-26 season.

SECTION III

PROGRAMME OF RESEARCH WITH BRIEF PROGRESS REPORTS AND SUMMARIES FOR FRUIT GROWERS.

Part I

Pomology.

Part I

POMOLOGY.

I. In relation to Tree Fruits.

Root Stock Investigations.

1. Stocks for Apples.

During last winter, the results of these trials under five different soil conditions, were summarised and compared with those of the " Mother " Plot at East Malling. This comparison not only confirmed the general principles deduced from the Mother Plot, but emphasised those modifications anticipated from differing soil and varietal conditions.

This analysis of the figures led to a preliminary study of the variability of individual trees on a single stock, thus providing information concerning the general conduct of field experiments with tree fruits. This study has revealed certain avoidable factors tending to increase variability, and, hence, to cloud experimental results.

The increasing age of the trees has established certain unexpected manifestations of stock influence upon habit of growth, time of blossoming, and time and mode of leaf fall. The heavy crops from all our trial plots have shown the influence of stock upon the size and colour of the fruit. Finally, the results obtained by working a wide range of varieties upon different root stocks has revealed the special suitability, or the reverse, of particular stocks for certain varieties.

2. Stocks for Pears.

Pear and Quince Stocks.

As in the case of many varieties of quince, several varieties of layered pears, originally selected from " Free " pear seedlings, have proved unsuitable as stocks, thus indicating another vital disadvantage in the case of mixed seedling stocks. This year for the first time, there are indications that one variety of quince stock (Type C.) encourages early cropping.

3. Stocks for Plums and Peaches.

A review of the seven years nursery work has demonstrated that incompatibility of stock and scion is really due to varietal, and not merely seasonal or manipulative, factors. Thus it is possible to caution tree raisers against the general use of certain stocks in commerce (Brussel, Common Plum, St. Julien

de Toulouse) and to indicate others (Mussel, Pershore, Damas C.) more desirable to raiser and grower alike. A number of new combinations of stock and scion revealed hitherto unsuspected incompatibilities and preferences, and also the fact that compatibility (or the reverse) is shown by a variety whether used as stock or scion.

The story is similar but even more emphatic in the case of peaches, and we have demonstrated that at least a proportion of the seedling " St. Julien " and " Damas " stocks frequently used are totally unsuitable.

4. Stocks for Cherries.

Observations in the nursery this year have not only further emphasised the points mentioned last year, i.e. more rapid growth, and greater uniformity of layered stocks than of seedlings,—but have also brought out more fully the striking differences in both botanical characters and the points of economic value (such as stoutness of stem, absence of feathering, freedom of rooting, resistance to black fly, etc.) between the different selections.

Contributory Factors Affecting Root Development.

The new material (referred to in our last report) designed for studying the relationship of shoot pruning to root development, has yielded results confirming and extending those previously obtained. Whilst pruning at the time of planting undoubtedly restricts the development of new roots of certain apple stocks, we are not able at present to give these results a full economic interpretation.

A further series of experiments, designed primarily to test the nursery practices of leaving or cutting away lateral " feathers " on young trees during the growing season, also gave very definite results in this direction.

Not only did the " defeathering " markedly check the thickening of the stem, but it also plainly reduced root development.

Double Working.

The deductions briefly outlined last year, at present chiefly of scientific interest, have been greatly strengthened by another year's records. The influence of the " Intermediate," though definite, seems frequently to be widely different from reasonable expectation. In one or two cases evidence seems to be accumulating of incompatibility between two scions ; in one case, that of Cox's Orange over a Bramley " intermediate " this incompatibility seems to warrant a caution to growers.

Pruning Experiments with Apples.

Since, as stated last year, this plot has now largely reached the end of its " adolesence," the accumulated records are already being studied in preparation

for a detailed report. Unsuspected relationships between growth, blossoming, fruiting, and disease resistance are coming to light and suggesting new lines for research.

Pruning Experiments with Pears and Plums.

The young trees set aside for these experiments have now made four years' growth, and have been differently treated for one and two years. Already the results are beginning to accumulate, and the different response of individual varieties is becoming obvious.

Manuring of Apples.

The trees on the unmanured acre definitely showed a falling off in wood growth, by the end of their fifth year from planting. It seems probable that trees on those stocks which are associated with leaf scorch show the greatest falling off, although the development of scorch has as yet been slight.

Certain plots of apples, manured with potash fertilizers, are yielding some suggestive results as to the effect of the manuring upon the fruit.

II. In relation to Bush Fruits.

Black Currants.

In the *Variety Cropping Trials*, Baldwin once more took first place. As a possible aid to the more accurate *classification* of "sub-types," their genetic constitutions are being studied, by "selfing." A new series of *pruning trials*, with Baldwin, has been initiated.

The second series of *manurial trials* is yielding certain consistently significant results, again emphasising the value in our soil of certain nitrogenous manures and the comparative lack of response to other dressings.

Considerable insight has been obtained into the *genetic constitution* of the five main varieties of Black Currant. After another season's fruiting, results will be ready for publication.

Several new seedlings have now proved themselves of sufficient merit to warrant working up in quantity for extended trial.

Red Currants.

A beginning has been made in the classification and description of our variety collection, and several fresh characteristics have been found useful for identification.

A beginning has been made in studying the genetic constitution of the main groups.

RASPBERRIES.

Out of 83 varieties in the preliminary cropping trials, 36 have been selected as worthy of inclusion in the final trials, which are to be planted in the coming winter. A report on the preliminary trials has been issued. Further additions to the variety collection are still coming in.

NUTS, ETC.

WALNUTS.

A collection of the principal varieties of Walnuts and other species of Juglans has been got together. Seedlings have been raised for stocks, and a beginning has been made in attempts at vegetative methods of propagation.

APPLE PRUNING: SUMMARY OF DEDUCTIONS.

By N. H. GRUBB.*

These notes bring up to date the outlines previously published of the results of the East Malling Apple Pruning experiments. They describe the deductions drawn from twelve years' work, with some advice as to their application in general practice.

The subject is treated under eight headings :—

A.—Objects and Methods of Pruning.

It may be said that the pruning of fruit trees is done with one or more of these objects in view :

1.—To shape the young tree, thereby facilitating such operations as spraying, cultivation, picking the fruit, etc.

2.—To furnish the branches with spurs. Some varieties, if left without tipping when young, are apt to make long bare branches with few fruit spurs.

3.—To maintain vigour, either

(*a*) To secure a tree of the required size, or

(*b*) To aid in setting enough blossom to produce a good crop, or

(*c*) To contribute to the general health and efficiency of the tree.

4.—To control the number and quality of the blossoms. This also may assist the setting of the blossom.

5.—To improve the quality of the fruit, particularly its size, colour, etc.

6.—To help in controlling diseases and pests.

By making efficient spraying easier.

By cutting out actual infections.

And probably also by a reaction of the pruning on the health of the tree, thus making it more resistant to certain diseases.

7.—To check and possibly help to control biennial bearing by equalising the strain on the tree.

8.—To help in renovating old and neglected orchards. Here pruning is nearly always the first treatment needed.

Three distinct operations may be recognised in the pruning of apple trees.

1.—"Tipping," i.e., the shortening of the "leader," the shoot that extends the branch. This operation is required mainly for shaping the tree, furnishing the branches with spurs, and maintaining vigour.

* Reprinted from *Kent Farmers' Union Journal*, Vol. XVIII., No. 5. November, 1925.

2.—" Thinning," either by

(*a*) Cutting clean out strong lateral and unneeded growths which crowd the tree, or

(*b*) Cutting back the weaker crowding growths to fruit buds where these are available.

3.—" Spurring," a two or three year operation. The weaker lateral shoots are first shortened to from three to five strong buds ; fresh growths resulting from this cut are again shortened until a definite blossom bud is formed ; the spur is then cut back to this blossom bud.

B.—Pruning required at Different Stages of Growth.

As far as pruning is concerned, the life of the tree may be divided into three periods :

1.—Shaping the young tree. In the first period, roughly up to four or five years, the object is to shape the tree and procure a sturdy framework with enough and not too many branches. It is generally necessary to shorten or " tip " the leaders severely at first and less severely later, removing perhaps $\frac{2}{3}$ or $\frac{3}{4}$ at first, and from $\frac{1}{3}$ to $\frac{1}{2}$ as the tree takes on the required shape. Little " spurring " is done in this period.

2.—Bringing the tree into bearing. In the second period the object is to bring the tree into cropping, more or less quickly, according to the variety and the length of life the tree is intended to have. The treatment required depends on the delay of cropping, which usually follows leader tipping ; for early cropping leader tipping must be quickly reduced in severity.

3.—Pruning the mature tree. The third period covers the maturity of the tree. It consists largely in thinning out the head of the tree, with, in certain cases, a moderate or even severe tipping of the leaders.

C.—Pruning must be adapted to Root Stock and Soil.

The delay in cropping due to leader tipping is relatively much greater amongst trees on vigorous stocks than amongst those on dwarfing stocks. Young trees on very dwarfing stocks will fruit even when severely pruned, while similar pruning might delay the cropping of trees on very vigorous stocks almost indefinitely.

In the same way trees on soils which normally produce dwarf growth can safely be pruned harder than trees, even on the same stocks, where growth is normally vigorous.

D.—Pruning Permanent and "Filler" Trees.

"Filler trees" are expected to crop quickly, and produce a good return before the permanent trees need the space. Leader tipping nearly always delays cropping; it can easily be overdone with fillers.

Note our results:—

Total crop in bushels per acre up to 9th year.

	Leader tipped.	Not tipped.
Lane's P.A.	82	242
Early Victoria	173	522
Grenadier	70	209

The untipped trees bore from three to four times as much fruit as the tipped trees up to the ninth year—a serious matter where early returns are imperative.

And "filler" trees need not have as stout a framework or as good a shape as is desirable for permanent trees—two of the chief reasons for the severe tipping of young trees.

E.—Effects of Over and Under Pruning.

Although it is important not to delay the cropping of "filler" trees unduly, there is another side to the picture. Quality of fruit counts also. Certain varieties, if left several years with no leader tipping (particularly if on certain dwarfing stocks) produce large quantities of very small fruit. Of these the worst are Allington and Cox's Orange, but several other varieties show the same tendency.

On the other hand, too much tipping before the trees crop often produces very dense wood growth, particularly with Allington.

In such cases correct pruning during the second period (see above) involves very light tipping, or sometimes none at all, until the trees bear well, then harder tipping to maintain size of fruit.

Quality counts also in the case of fillers. Entirely unpruned trees produce smaller fruit, and poorer coloured in the case of coloured varieties, than trees thinned out even with no tipping. The latter, in fact, produce the best coloured fruit of all.

F.—Maintaining Vigour.

The small fruit borne by untipped trees of Allington and Cox's Orange is connected with the weakness and unhealthy condition of the trees. In the early years the untipped trees behaved like other varieties in cropping well, whilst the tipped trees produced little fruit. But the untipped trees, particularly of Cox's Orange, soon became so weak and unhealthy that the fruit was very small, badly scabbed, and much of it worthless.

Many old and neglected orchards and plantations are in this condition. In such cases a fairly severe pruning, often with a moderate heading back of the branches, works wonders in improving the quality of the fruit and often also the quantity.

G.—Pruning helps in Controlling Diseases and Pests.

The tipped trees in our experiments have been notably freer than the untipped trees from Scab, Mildew, ordinary Apple Canker, and Blossom Wilt Canker.

This is no doubt chiefly due to the removal by pruning of sources of infection. It pays to cut away all diseased wood at the winter pruning.

But pruning also makes the tree easier to spray, by keeping the head more open and accessible. This helps in the control of insect pests as well as diseases.

It is probable also that the leader tipped trees are actually more resistant to certain diseases, particularly scab and canker.

H.—Pruning must be adapted to the Variety.

Varieties differ very much in their habit of growth and cropping. A method of pruning which gives excellent results with one variety may be quite unsuitable for another, even under similar conditions.

For example, Worcester Pearmain, when young, produces most of its fruit buds on the tips of shoots 6 inches to 18 inches long. If these are cut away there may be a quite unnecessary delay in cropping. Newton Wonder, on the other hand, produces natural spurs more freely than Worcester whilst young (unless over-pruned). In our experiments cutting away the tip fruit buds of Newton has not reduced the crop. Note these figures :—

Number and weight of fruits per tree, 8th year.

	Not tipped.			Tipped.		
	Fruits.	lbs.	ozs.	Fruits.	lbs.	ozs.
Worcester Pearmain	214	31	0	32	7	0
Newton Wonder	42	9	12	56	16	2

This is only one example of the need for pruning different varieties differently. Others are given below.

It is necessary to distinguish between upright growing varieties and those that naturally make spreading trees ; in tipping the leaders upright varieties should be cut to outward buds, spreading varieties to inward or upward buds.

Upright.	Spreading.
Annie Elizabeth.	Lane's Prince Albert.
Lord Derby.	Allington.
Worcester Pearmain.	Beauty of Bath.
	Gladstone.

Some of these are spreading varieties, and some others with slender branches, are apt to become very drooping when old, unless the leaders of the young tree are tipped. The worst in our experiments are—Lane's Prince Albert, Allington, Cox's Orange, and Lord Derby.

Certain varieties, again, are apt to make long bare branches with few spurs, unless the leaders of the young tree are tipped. In our trials Bismarck has been the worst in this respect, followed by Newton Wonder, Worcester Pearmain and Annie Elizabeth. Six varieties show this tendency hardly at all :—Lane's Prince Albert, Lord Derby, Allington, Grenadier, Early Victoria, and Norfolk Beauty.

Finally, certain varieties may be distinguished which, when young, produce most of their fruit buds on the tips of shoots, more or less like Worcester (see above); whilst others produce natural spurs freely, unless severely tipped. Examples of the former, which in our conditions produce few natural spurs up to the eighth year, even when unpruned, are :—

Bramley's Seedling.
Worcester Pearmain.
Bismarck.
Gladstone.
Grenadier.

Varieties producing natural spurs freely are :—

Lane's Prince Albert.
Early Victoria.
James Grieve.
Cox's Orange.
Allington.
Lord Derby.
Rival.

APPLE ROOT-STOCKS, THEIR PARTICULAR SUITABILITIES FOR DIFFERENT SOILS, VARIETIES AND PURPOSES.

A Summary by R. G. HATTON.

It has been shown at East Malling, after making observations on units of twenty to thirty trees on each root-stock, that it is possible by the use of different varieties of Layered Apple Stocks (so-called " Paradise "), to obtain a very large measure of control over :—

(*a*) The vigour of the tree, as expressed in the amount and rate of growth.

(*b*) The habit of growth and fruiting, and season of blossoming.

(*c*) The age at which the tree first produces blossoms and fruit.

General Grouping of Apple Stocks.

As a result of these experiments, Layered Apple Stocks have been as follows :—*

A.—Very Dwarfing Stocks.

Such as Jaune de Metz Paradise (Malling No. IX.), suitable for very quick cropping bush trees on good land, cordons and trained trees in small gardens.

B.—Semi-Dwarfing Stocks.

Such as Doucin (Malling No. II.), suitable for moderate sized, quick-cropping bush or trained trees, except for weak growing scions.

C.—Vigorous Stocks.

Such as Broadleaved English ' Paradise ' (Malling No. I.), suitable for bushes of the weaker growing sorts, large permanent bushes, and even moderate sized half standard trees.

D.—Very Vigorous Stocks.

Such as the unnamed layered free growing stocks (Malling Nos. XII., XIII. and XVI.,) suitable for the weakest varieties as bushes and for large standard trees.

The performance of Lane's Prince Albert on these four different groups of stocks is well illustrated by our records of six and seven year old trees growing in good medium loam at East Malling. The following Table gives a summary of these results.

* Choice of Young Fruit Trees. Hatton, Grubb and Amos. Ann. Rep. E.M.R.S. 1924, page 93.

TABLE I.

Records of Lane's Prince Albert. First seven years, to May, 1926.
Averages per tree.

On Stock Group.	Total length Wood Growth. cm.	Average height at date. cm.	Average Spread at date. cm.	Girth at 25 cm. at date. mm.	Total Fruit Buds. No. to 7th year.	Total Fruits No. to 6th year.	Total Fruits No. to 7th year.
A. Dwarf. Metz IX. ..	4,695	132	176	108	326	61	112
B. Semi-Dwarf. Doucin II. ..	10,915	203	222	173	309	20	65
C. Vigorous. Broadleaf I. ..	15,930	242	245	207	277	11	65
D. Very Vigorous. Free XII. ..	23,332	275	277	237	90	0.5	10

As will be seen later (Table II.) a strikingly similar result was obtained on a smaller plot of trees at East Malling a year older.

In each case the relative order of vigour remains the same, and in each case the relative order of cropping is the converse of that of vigour. In both cases the peculiar value of groups A and B as dwarf fillers, up to the end of the sixth year, is demonstrated, and then already by the seventh and eighth year there are clear signs that the more vigorous groups C and D are catching up in number of fruits.

NATURE OF THE DIFFERENCES RESULTING FROM THEIR USE.

Statistical examination of these records has shown that the grouping we have made, and the differences we have demonstrated, are significant, according to the standards of reliability usually applied to such trials. The chances are, in most cases, many hundreds to one that repetition of such trials, under similar conditions, would give similar results. The differences are therefore not accidental, but are *real differences* due to stock influence. That there is still bound to remain some measure of individuality amongst the trees in any one group will be obvious, since it is impossible to control completely all the factors, such as soil variation, likely to influence the tree. However, the common group characteristics caused by stock influence, e.g., vigour and fruiting, habit of growth and season of blossoming, etc., are generally well maintained and are not really obscured by these slight local variations. If the variations found amongst trees upon standardised stocks be compared with the degree of variation to be found amongst trees on mixed or seedling root-stocks, the difference will usually be seen to be very great.

Stock and Variety.

The general deductions are greatly strengthened by two further facts. We can show, first, a similar range of influence on other varieties, widely different from Lane's Prince Albert, such, for instance, as Bramley's Seedling, Worcester Pearmain, Cox's Orange Pippin and Stirling Castle. A considerable measure of control has been obtained over the behaviour of trees of all these, and other varieties, though some are affected relatively more and others relatively less than Lane's Prince Albert. Thus similar data for these varieties show differences sometimes more and sometimes less significant.

Stock and Soil.

Secondly, our deductions are still further strengthened by the behaviour of other experimental plots planted up with similar, though smaller, units of trees, and kept under our control and observation. The trees of Lane's Prince Albert are, as our records prove, acting in exactly the same way on the five different soils in which they have been tried. These soils differ widely from the good medium loam at Malling which has approximately 60 per cent. of Fine Gravel and Sand and 30 per cent. of Silt and Clay. At the one end are very stiff clays where 77 per cent. is Silt and Clay, and only 16 per cent. Gravel and Sand, and, at the other, a very light Sand where 96 per cent. of the soil is classed as Fine Gravel and Sand, and less than 2 per cent. as Silt and Clay.

In each case the relative order of vigour and precocity has been the same as on the central plot at East Malling. On the other hand, the very important fact has been well demonstrated that root-stock must be selected in relation to soil conditions as well as to scion variety and purpose of the tree.

Compare the records at the five centres in Table II.

From this Table (II.), it will be seen that, although the size of tree on any given stock is markedly different on different soils, yet on every soil the dwarfing stock (Group A) Jaune de Metz (No. IX.) gives smaller trees of Lane's Prince Albert, than any other group of stocks on the same soil. In all cases but one, these trees are too dwarf even to be considered as a commercial proposition, though they might thrive in made garden soils on such formations, or under different conditions of cultivation. At the other end of the scale, trees on the Very Vigorous Stock (Group D), such as Malling Free Stock No. XVI., are too big for filler bush trees on the richer commercial soils, and would be far too rampant for the garden. It is quite plain that the best stock for the purpose cannot be chosen without a knowledge of the soil and conditions in which the tree is to grow.

Variety of Soil considered together in relation to Root-Stock.

Again, it is the same with variety. Under certain conditions, such as at East Malling, small bush trees of Worcester Pearmain and Cox's Orange Pippin

TABLE II.

	Average Total Growth					Average total cropping figure for 5 years.					Average total cropping figure for 6 and 7 years.				
	Malling.	Swanley.	Wisley.	Wisboro.	Tunstall.	Malling.	Swanley.	Wisley.	Wisboro.	Tunstall.	Malling.	Swanley.	Wisley.	Wisboro.	Tunstall.
	Medium loam.	Gravel loam over chalk.	Sand.	Heavy Clay.	Clay with flints.										
	8 yrs.	8 yrs.	7 yrs.	7 yrs.	7 yrs.	5 yrs.	5 yrs.	5 yrs.	5 yrs.	5 yrs.	7 yrs.	7 yrs.	6 yrs.	6 yrs.	6 yrs.
Group A. Dwarf (IX.)	14,312	2,615	316	‡no trees		37	39	60†	‡no trees		146	74	34	‡no trees	
B. Semi-Dwarf (II). ..	24,232	9,533	578	2,714	1,782	26	29	84†	33	1	119	71	40	—	—
C. Vigorous (I.)	30,666	13,684	681	4,361	2,342	17	14	13†	26	0	98	96	28	—	—
D. Very Vigorous (XIII. to XVI. and Long Ashton No. 5)	43,499	10,591*	2,485	3,470*	‡no trees	5	6	2†	18	‡no trees	153	33	10	‡no	trees

* Owing to shortage of trees on these stocks at time of planting, the maidens here could not be so carefully selected, and second grade trees had to be planted which were not strictly comparable.

† These figures are not strictly comparable with the other columns, since they represent the average number of blossom spurs, and not the actual fruits set, as in the other columns.

‡ Sufficient trees of Lane's P.A. on these groups of Stock were not available for these plantings, but similar results with trees of Bramley's Seedling and Worcester Pearmain on this soil, bear out the general conclusions.

become a tempting commercial proposition even on the Dwarfing Jaune de Metz (Malling No. IX.); under exactly the same conditions and on the same stock, weak-growing varieties like Stirling Castle and Heusgen's Golden Reinette are stunted to a complete standstill. The Table (III.) below gives an indication of the differences in vigour which have resulted on different soils with two very distinct varieties, Lane's Prince Albert and Bramley's Seedling. It should be possible in time to construct such tables for all possible combinations of soil and variety. Such tables should be a valuable guide in planning orchards.

TABLE III.

Behaviour of Bush Lane's and Bramleys on Different Stocks under various conditions. Stock Group.

Type of Conditions.	A.	B.	C.	D.
	Dwarf.	Semi Dwarf.	Vigorous.	Very Vigorous.
		LANES.		
Malling (Medium Loam) ..	Moderate	Good	Vigorous	Very vigorous
Swanley (Sandy Loam) ..	Small	Moderate	Vigorous	Vigorous
Wisboro' Green (Heavy Clay) ..	—	Moderate to poor	Good	Vigorous
Tunstall (Clay with Flints) ..	—	Poor	Moderate	—
Wisley (Light Sand) ..	Very poor	Poor	Small	Moderate
		BRAMLEYS.		
Malling ..	Good moderate bush	Vigorous	Very vigorous	Too vigorous
Swanley ..	—	Good	Vigorous	—
Wisboro' Green	Very small	Good, small	Good	Vigorous
Tunstall	—	Moderate	Good	—

STOCK AND PURPOSE OF TREE.

There is one further major consideration which must influence our selection of trees upon particular stocks, that is, the purpose for which the tree is designed. This is equally important to the Commercial Grower and the Amateur Gardener. Is the tree intended for a orchard standard, a large bush, a small quick-cropping bush, an espalier or a cordon ?

Not infrequently ground is wasted, or, on the contrary, trees are over-crowded in the plantation, because the trees have been interplanted upon stocks unsuitable for the purposes contemplated. Sometimes the grower finds the early crops he reckoned upon do not materialise. Sometimes it may be the tree never develops into the large orchard tree that was required. For instance, a glance at Table IV., which shows the estimated rate of cropping per acre in the

first seven years, based on the records of Lane's Prince Albert on the good East Malling loam, planted at distances suitable to the size of tree, gives some idea of the importance of the suitable tree for a particular purpose.

TABLE IV.

Rate of Cropping of Lane's Prince Albert in Bushels per Acre on Group :—

	A. IX.	B. II.	C. I.	D. XVI.
Possible number of "fillers" per acre.	504	268	150	101
1920 2nd year* ..	Nil	Nil	Nil	Nil
1921 3rd ,,	35	13	Nil	Nil
1922 4th ,,	71	21	4	Nil
1923 5th ,,	130	54	22	3
1924 6th ,,	357	200	126	29
1925 7th ,,	530	302	150	120
Total Yield ..	1,123	590	302	152 Bush.

From what has already been said it will be realised that the figures in this Table refer only to the one variety, Lane's Prince Albert upon the Malling soil, and that they must not be used for estimating results under other conditions.

The figures are not intended to convey the impression that the trees on any one stock are the best *absolutely*. They show definitely the superior cropping capacity of the trees on the dwarfing stocks during their early years, but it is extremely likely that at the end of a further five years the crops from the trees on the more vigorous stocks will have equalled or exceeded those from the trees on the more dwarfing stocks.

This does not signify that we expect the crops from the dwarf trees to decrease, or that these trees will necessarily have a short life, but simply that we expect the crops from the vigorous trees to increase more rapidly as they come into full bearing. A point that must not be overlooked is the enhanced value of the crops from the dwarf trees owing to the much earlier returns upon capital invested.

In the garden, much of the overcrowding, shading of undercrops, unfruitfulness, and rampant wood growth, with the consequent need for root pruning, can be avoided by a judicious selection of the more dwarfing stocks.

By using these in made garden soils, it is possible for the amateur to plant these small bushes or controllable cordons more closely, so that he may greatly extend the ranges of flavour and season in his collection of apples. As an example of what may be achieved, our Cordon Cox's on Metz (No. IX.) have made

* i.e. from planting as Maiden Trees.

only half as much wood growth, yet have produced actually more and better fruit, than a similar series on Holstein Doucin (No. IV.). The owner of the small garden may even hope to grow specimens of vigorous usually slow cropping yet prized varieties like Blenheim Orange and Belle de Boskoop in fertile cordon form.

The tree planter should be explicit as to his conditions and requirements, and seek the advice of good tree raisers, for, although our general grouping of stocks has been repeatedly shown to be trustworthy, yet it must be emphasised that any rule of thumb selection of stocks must be modified by considerations of Variety, Soil and Purpose.

Other Factors influencing Selection of Stock.

Other important, if less fundamental effects of stock are deserving of consideration in selecting one's trees. Except where trees are to be trained on walls or wires, or are very sheltered, roothold is very important to the grower. For this reason, unless he is prepared to give constant attention to re-staking, we cannot recommend him to plant really heavy headed varieties, such as Bramley's Seedling, on either of the dwarfing groups (Groups A and B). Again, if a grower has to rely upon tractor and horse cultivation entirely, he will do well to avoid the very dwarf spreading fillers on No. IX., however good his soil may be, for this alteration in the tree's habit is a very real one.

On the other hand, the grower who is ambitious to try his hand at growing the finest quality dessert fruits, or the tenant farmer seeking quick returns, will, if his growth conditions are good, be not unwise to look upon these stocks favourably. The more intensively a grower is prepared to cultivate, the more likely he is to succeed with the very dwarfing stocks; they are not suitable for "average" conditions. For instance, whilst trees upon the more vigorous stocks may be grown successfully with little pruning, those on the dwarfing groups can not only stand more severe pruning but will almost certainly require it. Then there is the question of season of blossoming. In places that are under suspicion as to late frosts, a planter might well think it worth while to plan his ground so as to use trees on some of the vigorous stocks causing late blossoming.*

Though there are some indications that stock influence may discourage or aid certain insect pests and fungus attacks, our information is as yet too fragmentary to justify the indication of definite selection along these lines.

However, there are now so many other factors to influence our selection, that we can well afford to await further information. Full details of these considerations have already been published in our Annual Report for 1924.

* Some Factors influencing the Period of Blossoming of Apples and Plums. R. G. Hatton and N. H. Grubb. Ann. Rep. E.M.R.S., 1924, page 81.

Part II.

Physiology.

Part II.

PHYSIOLOGY.

In Collaboration with the Plant Physiology Department of the Imperial College of Science and Technology.

Programme of Research with brief Progress Reports.

By R. C. Knight.

1. Water Relations of Apples.

(*a*) *Conductivity.*

The capacity of stems of various stocks to conduct water has been determined. The technique of the experiments has been improved and some variable factors controlled, but the variation among apparently similar individuals is still found to be considerable, and this variation must apparently be accepted as inevitable. In spite of this, differences have been found in the conducting capacity, calculated per unit area of cross section of wood, of stocks of different types. The investigation is not yet sufficiently complete to show whether high conductivity is always associated with the vigorous types, although in three of the four classes of stocks so far tested, there is a gradation of conductivity corresponding with the gradation of vigour.

The investigation is being extended to other stocks and to scions worked on different stocks.

The extent to which the union (bud or graft) restricts the flow of water is being investigated. The wood elements which were in existence at the time the graft was made, soon become blocked in the region of the union, and subsequent to this blocking, any water passing the union finds a path through newly formed wood. Thus the conductivity of a piece of stem which includes a graft is always low, on account of the fact that the wood formed previous to grafting does not function.

A piece of stem in the vicinity of, but not including a graft, shows normal conductivity, even though it contains wood elements formed previous to grafting. Thus the older wood is blocked only in the immediate vicinity of the union.

It has not yet been determined how soon after grafting the blocking of the existing wood takes place.

In plums there is evidence that the " pre-graft " wood becomes blocked over a considerable length, since gumming is visible after a year or two, over

a length of several inches from the graft. The same phenomenon appears below pruning wounds.

These facts indicate that the conductivity for water can hardly be an important factor in the growth of the tree. A scion during the Summer following grafting has two seasons' growth at its base and one season's growth above, all of which is adequately supplied with water (as indicated by its normal growth) which must be transmitted across the union entirely through the current season's wood.

(*b*) *Water Content and Specific Gravity.*

A further season's records have been obtained showing the usual cycle, and a preliminary survey has been made of the carbohydrate changes accompanying the seasonal cycle of growth and water content in the stem. A decrease in carbohydrate content occurs in the early part of the growing season.

2. Propagation.

(*a*) *Hard-Wood Cuttings.*

A further season's results have been obtained confirming the view that the callusing of hard-wood cuttings is favoured by high water-content of the soil and that the production of roots is favoured by good aeration conditions.

It had already been shown that cuttings planted in a clay soil with a high water-content, callus more freely than cuttings in sand. This season it has been demonstrated that if the cuttings in sand are heavily and constantly watered, they produce a callus approximately similar to that which develops in clay.

Hard-wood cuttings in soil top-dressed with lime showed a much higher percentage rooted (34 per cent.) than those in soil to which ammonium sulphate had been added (8 per cent.), indicating that soil acidity may have an influence upon rooting. This line is being followed up.

Further experiments on the position of the basal cut relative to the nodes of a cutting have shown in every case so far dealt with that quicker rooting is obtained when the basal cut is midway between two nodes than when the cut is (as in traditional practice) immediately below a node.

(*b*) *Soft-Wood Cuttings.*

Extension of the tests with soft-wood cuttings in relation to the condition of the cutting, the period of the trial, and the medium used, has given results similar to those previously obtained, although some results were different in degree, probably as a result of the impossibility of controlling conditions completely.

Some batches of etiolated plum cuttings showed a high proportion rooting.

3. Field Experiments.

Observations on the trees in these experiments (see Ann. Rept., 1924, p. 104) are being continued, and a further series of double-worked trees is being prepared in a manner which will obviate the influence of the one year's growth of the intermediate upon the root system before the introduction of the second scion.

A summary of the results so far obtained in these experiments will be published shortly.

4. Growth.

(*a*) A trial of the influence of stem pruning on subsequent root and shoot growth has indicated that new stem growth and new root growth are closely correlated quantitatively, and their relationship is unaffected by pruning. The distribution of new stem growth, however, is profoundly influenced, more severe pruning resulting in a greater proportion of new growth taking the form of new stems and a less proportion taking the form of thickening of existing stems. Material is in preparation for a repetition of these trials.

(*b*) Confirmation has been obtained in 1925 of the observation made in 1924 that in Spring, when the buds are developing, the formation of new lignified elements in the parent stem is closely associated with developing buds. The regions of the stem which the buds remain dormant do not show any increase in the number of new wood elements at this season, whilst the stem in the region of active buds may show several rows of new tracheæ. The thickening extends later to the bare portions of the stem. This observation may have a direct bearing upon practical problems such as the treatment of laterals on young standard trees and the formation of a union in nursery practice. See page 38.

Part III.

Plant Pathology.

Part III.

PLANT PATHOLOGY.

Programme of Research with brief Progress Reports.

Brown Rot Diseases.

1. The comparative study of strains of *Sclerotinia cinerea* from various hosts has been continued.

2. *Distribution of the Brown Rot fungi.* Further cultures of Brown Rot fungi have been received from abroad and these are being compared with the strains already collected.

3. *Pear Blossom Wilt.* The fungus causing this disease has been studied culturally for comparison with other strains of *Sclerotinia cinerea.* A serious outbreak of the disease on Fertility pears has come under observation from Wisborough, Sussex.

4. Inoculation experiments of stool shoots of plum stocks have been initiated with a view to determining whether *S. cinerea* is the cause of the wilt.

5. Inoculations have been made with conidia of *S. cinerea* on unopened flowers of the Morello cherry. Positive results have been obtained in a few cases and the experiments will be continued as they indicate the use of a pre-blossoming spray for controlling Blossom Wilt of Morello cherries.

6. *A Leaf-blotch of Quinces* on the Research Station has been studied and found to be caused by *Sclerotinia Cydoniæ*, a fungus not previously recorded for this country.

Crown-gall.

1. Inoculation experiments have been continued (using pure cultures of organisms isolated from apple galls) on apple stocks from stools and also on soft wood cuttings.

2. "Burr-knots" on fruit trees have been studied to ascertain whether they have any connection with Crown-gall. The observations made afford evidence that "burr-knots" are not a form of Crown-gall.

The Possible Effect of Root-stock on Susceptibility of the Scion to Diseases.

The influence of the stock on the scion is being studied in relation to the following diseases:

1. *Apple Canker.* Inoculations with the Apple Canker fungus (*Nectria galligena*) have been made on Bramley's Seedling scions grafted on stocks which show different degrees of susceptibility to the disease.

2. *Leaf Scorch.* Field records on the incidence of Leaf Scorch on the trial plots have been continued by the Pomological Department.

3. *Silver Leaf.* Field observations on Silver Leaf on the plum stock trial plots have been continued by the Pomological recorders in collaboration with Mr. F. T. Brooks.

4. *Apple Mildew.* Records are being taken on the apple stock trial plots of the number of mildewed shoots on scions of various stocks.

Raspberry Diseases.

Mr. R. V. Harris has continued his investigations in relation to the following diseases :

1. *Blue Stripe Wilt.* Monospore cultures of the fungus causing this disease have been prepared and cultural studies of the organism have been made in order to compare it systematically with strains of Verticillium from other hosts and with type cultures of various species of the genus. Observations on the degree of susceptibility of the various varieties of raspberries to the disease have been carried out. Field plots have been planted out to ascertain how far the disease is transmitted by the ordinary methods of propagation and preliminary experiments have been made to investigate methods of raising disease-free stocks.

2. *Cane and Leaf Spot.* The fungus associated with this disease has been isolated and studied in pure culture. Two stages in its life-history have been found on infected canes, and the organism is found to correspond closely with (it is probably identical with) *Plectodiscella veneta,* the cause of " Anthracnose " on raspberries in America. Field observations have been made to compare the susceptibility to this disease of the varieties of raspberries grown on the Station.

3. *Mosaic.* In collaboration with the Pomological and Entomological departments, experiments have been started with the object of determining whether the disease is one of the " Virus diseases," and if so how it is transmitted. Varietal susceptibility has been studied and field experiments for ascertaining methods of raising and maintaining disease-free stocks have been started.

Hop Wilt.

Mr. Harris, continuing his work on this disease, has again isolated a species of *Verticillium* from wilted hop bines and there is circumstantial evidence therefore that the fungus found associated with this disease is the cause of the wilt. Inoculation experiments have been carried out, but up to the present with negative results.

Hop Leaf Spot.

Inoculation experiments were carried out on a number of commonly grown varieties of hops using the hop leaf-spot fungus (*Cercospora cantuariensis*). All the varieties tried proved susceptible to the leaf-spot disease.

Grey Mould on Hops.

Observations have been made on a disease of hop cones which starts as a browning of the tip and causes a rot. *Botrytis cinerea* has been found to be invariably associated with this disease and is presumably the cause.

Leaf Blotch of the Shasta Daisy.

A disease of the Shasta Daisy has come under observation. The fungus invariably associated with the disease was found to be *Septoria Leucanthemi*, a fungus which had not previously been recorded in this country. A description of the disease and fungus has been published.

Bacterial Shoot-Wilt and Die-back of Plum and Cherry Trees.

Inoculation experiments with a bacterium obtained from wilted plum shoots have given rise to the wilt symptoms on young shoots, and have produced cankered areas on branches. The results suggest that the shoot-wilt organism of plum trees can infect older tissues, although actual killing back (except of young green shoots of the current year) has not yet been obtained by inoculations. The same organism inoculated into leaves by punctures has produced the symptoms of "leaf-spot" and "shot-holes."

Inoculations on cherry shoots and leaves with an organism obtained from a leaf-spot on a cherry leaf have given rise to lesions at the inoculated spots.

Turnip Bacterial Rot.

The study of the bacterial soft rot of garden-grown turnips, caused by *Bacillus carotovorus* has been continued and the results published.

Black Rot of Crucifers.

Seedling plants of Broccoli and Savoy grown on the Station showed symptoms characteristic of the disease known in America as "Black Rot." As this disease has received but little attention in this country, the plants were kept under observation. Miss Frampton has isolated a bacterium from infected leaves and has carried out tests for identification. The tests gave results similar to those recorded for the Black Rot organism, *Bacterium campestre*, but inoculation experiments to test for parasitism have not been yet carried out.

THREE RASPBERRY DISEASES.

By R. V. HARRIS.

Introduction.

In 1916 the Research Station started a collection of named commercial varieties of raspberry with the primary object of testing the effects of artificial manures on the quality of the fruit. Very soon, however, the presence of rogues in many of these varieties indicated the want of a standard system of classification. Such a system was eventually evolved by Mr. N. H. Grubb.* For the purpose of Mr. Grubb's investigation the collection was greatly extended, every possible named sort of raspberry from different and widespread raspberry growing districts being included. As this collection of varieties became established it was found that the comparison of different varieties as to their cane and fruit producing capacity was considerably impeded by several diseases which attacked some varieties very severely, whilst other varieties on the same plantation remained free from disease. The study of the pathology of the raspberry thus became a very necessary branch of the study of the relative merits of the different commercial varieties. Such a study was commenced by the writer in the winter of 1923.

The first disease to receive attention was a wilt, which in certain varieties was responsible for the death of a large proportion of the new and fruiting canes. The cause of this disease (a fungus) has now been determined and a detailed analysis of symptoms in the field has been made.† A study of the habits of the fungus causing the disease has made it possible to suggest certain precautionary measures against attack. This disease is now known as the "Blue Stripe Wilt of the Raspberry," and has been found to be generally distributed throughout the country.

Work was subsequently commenced on two other diseases of economic importance to the raspberry crop at East Malling, which, like the Blue Stripe Wilt, appear to be widespread; these are Raspberry "Mosaic" and a Cane Spot Disease.

The cause of the former of these diseases is at present unknown. Constantly associated with the latter is a fungus which is probably the cause of the cane spot, as it is similar to a fungus which, in America, has been proved to be parasitic.

* See *Journal of Pomology*, Vol. III, No. 1, Nov., 1922.

† See Annual Report of the East Malling Research Station, for 1924, "The Blue Stripe Wilt of the Raspberry."

It is obviously of great importance to the grower to be able to recognise and distinguish these diseases in his plantation in order that he may take the right precautions against them. The object of this article is to enable the grower to do so, and to suggest control measures which our study of the diseases up to date has suggested.

2. The Causes of the Diseases and their Recognition in the Field.

(*a*) *The Blue Stripe Wilt.* This disease is caused by a fungus which is present in the rootstock of the stool and which works up thence into the canes, weakening and eventually killing them.

The symptoms of this disease are fully described in the paper on the disease already referred to.* Here it will only be necessary to emphasise those features which distinguish it from the other two diseases to be dealt with later. The first important point to note is that the fungus causing this disease is rarely seen on the outside of diseased canes, either on the stems, leaves, flowers or fruit. It only appears, and that rarely, on dead canes, in the winter, in the form of minute black dots in the bark which can be seen by means of an ordinary pocket lens.

The symptoms most reliable for the identification of the disease, however, are those which appear on the new canes. From about the end of June onwards new canes of infected stools start to wilt and die. Sometimes an unmistakable blue stripe appears on the cane, working up the cane from soil level. At the time of the appearance of this blue stripe the leaves of the cane wither very rapidly and fall off, the lower leaves always being the first to be affected. More generally, however, the withering of the leaves takes place less rapidly and commences for some time before the blue stripe appears on the stem. The appearance of this stripe may be delayed until the winter or the following spring, or it may not appear at all. In these cases the leaf takes on a striking striped appearance, caused by the withering of the parts of the leaf between the main veins, the veins persisting green for a long while. The edges of the leaf also curl upwards, showing the white under surface. Again the lower leaves are always the first to become striped and detached, the terminal tuft often persisting long after the lower leaves have all fallen. This striping of the leaves is perhaps the most general and easily recognised symptom of the disease (see Fig. 1). The appearance of the blue or dark stripe on the cane means that the fungus is travelling up inside the wood of the cane. The wood infected with the fungal threads loses its green colour, becomes dark coloured and causes the blue stripe to appear. The spread of the fungus round the whole of the cane is often very slow. Thus, many canes are found in the autumn and winter which, on cutting, are found to have a dead strip of wood running continuously up the cane from ground level, the remainder of the wood being green. It is plain that when the buds of such

* See Annual Report of the East Malling Research Station for 1924. "The Blue Stripe Wilt of the Raspberry."

a cane shoot in the spring, the buds present on the dead strip of wood will not shoot, and actual observation confirms this.

In the spring, fruiting canes with a row of dead buds down one side of the cane are very common. Later, such canes are often completely killed and in any case rarely produce good fruit.

(*b*) *The Cane Spot Disease.* Associated with canes infected with this disease is a fungus which resembles closely one proved to be the cause of a similar disease in America. It is therefore highly probable that this fungus is the cause of the disease in this country. Inoculation experiments to prove this point are in progress.

The disease is very different in nature from the Blue Stripe Wilt. Whereas in the Blue Stripe Wilt the canes are infected through the roots, in the Cane Spot Disease the canes are infected by spores produced on the surface of previously infected canes and carried to other canes. Also in this disease, infection is confined to the outer part of the canes whereas in the Blue Stripe Wilt the fungus is rarely seen on the surface of diseased canes but lies deep in the wood. In severe instances the Cane Spot Disease causes the death of the whole or a portion of the cane. In the latter case, however, it is the upper portion of the cane which first dies, whereas in the Blue Stripe Wilt, death takes place upwards from the base of the cane.

As will be suspected from the name of the disease, each infection results in a spot, which remains quite small, not usually exceeding an eighth of an inch in diameter.

The disease is first seen in late spring from the end of May to the beginning of June, when small, dark purple spots are noted on the young new canes. As these spots increase in size, the central portion becomes greyish in colour, but bordered by a purple ring (see Fig. 2). Finally, as the growth of the cane proceeds, these spots become sunken, forming shallow depressions extending through the soft tissues of the bark as far as the wood.

Similar ringed spots also appear on the leaves. These spots are very minute in size and are often aggregated together in patches which lie between the main veins of the leaf. The individual spots however can always be seen with a pocket lens. Towards the end of the season the nature and extent of the damage caused by the disease to the new canes is more apparent. In severe cases where the number of spots is large, they run together, forming large canker-like wounds. Such badly attacked canes make little growth and are generally under-developed, the canes often being dead from the tip for a long way down. The upper parts of badly infected canes have a contorted appearance. Badly infected leaves are often curled, the petiole in many cases being badly cankered with this disease.

It will be seen that the fungus damages and impedes the growth of the cane only when it eats into the cane, making a shallow depression and in bad cases exposing the wood. All infections, however, do not go so far. Late in the season if new canes are examined after the bark has become hardened, crowds of little white spots, which are not sunken, but purely superficial, will be seen. Where these are very numerous, the outline of the individual spots is lost and an irregular whitish patch is formed on the bark. If these little white unsunken spots are examined with a lens, from late autumn onwards, a little group of minute black dots will be seen on each of them. This is the commencement of growth of the fruiting stage of the fungus which is suspected of causing the disease.

(*c*) *Raspberry "Mosaic."* The cause of this disease is at present unknown, though the symptoms indicate that it is one of the *Mosaic Diseases*. Infection experiments in proof of this are in progress at the time of writing. The chief symptom of the disease is a mottling of the leaves of affected new and old canes. This mottling effect is due to the appearance of discoloured patches scattered over the leaf. These patches may be a distinct yellow and slightly sunken when the leaf has a blistered appearance, or they may be but slightly paler than the rest of the leaf and so hardly distinguishable. Usually the leaves of infected stools do not show traces of mottling on the leaves until the season is well advanced. The leaf mottling is often accompanied by a downward curling of the leaf (see Fig. 3). The canes of badly affected stools are also very dwarf and bear little or no fruit. In cases of slight infection the stools appear normal except for a slight speckling, just distinguishable on some of the leaves.

During the season of 1925 there was evidence at East Malling that the severity of attack is increasing in some varieties. In some cases the canes are so dwarfed that the stools are almost obliterated, and there is no doubt that in certain varieties the disease can have disastrous effects on the crop.

3. Control of the Diseases.

In considering the control of the three diseases described above there are two obvious points of view to be taken: (a) that of the grower who wishes to plant up a new plantation, (b) that of the grower who wishes to control disease in a plantation already established. The discussion which follows will therefore fall under these two heads.

(*a*) *The new plantation.* The first point to be considered by the grower about to plant up raspberries is the selection of suitable varieties. One of the most interesting conclusions reached in the study of raspberry diseases at East Malling is the difference that exists between varieties with regard to their resistance to disease. This applies to each of the three diseases described above.

Of two adjacent rows on the plantation, each of a different variety, one may show bad infection by Blue Stripe Wilt, Cane Spot or " Mosaic," and the other be almost free. For instance, at East Malling the *Baumforth B* variety is very susceptible to the Cane Spot disease. The 1925 crop from this variety was practically nil owing to a serious attack of the disease in 1924, which was confined to this variety.

Similarly, *Bath's Perfection* is very susceptible at East Malling to the Blue Stripe Wilt and the *Superlative* variety to " Mosaic." *Baumforth B.* and *Bath's Perfection* have also been found to be susceptible to these diseases in other parts of the country, so that susceptibility would appear to be something inherent in these two varieties.

It does not necessarily follow, however, that other varieties which are susceptible to a particular disease at East Malling will be susceptible to that disease if grown elsewhere. Bearing in mind, however, the large range of different distinct varieties available to choose from and the large differences between these varieties with regard to their capacity for resisting disease, the selection of the variety to be planted up is very important. Considerable data have already been collected as to the susceptibility to disease of commercial varieties at East Malling, and a survey of disease on these varieties in other districts is being made. Meanwhile, the importance of a careful choice of variety can be seen, and the grower is advised to experiment on a small scale with varieties which are promising from the disease-resisting point of view, with the object of ultimately finding a variety which makes healthy growth under his conditions. After the grower has selected his varieties, precautions must be taken to obtain disease-free stock of these varieties, for planting up. This precaution is especially essential in the avoidance of the Blue Stripe Wilt and " Mosaic " diseases. The seat of the trouble in each of these diseases is the infected rootstock system, and thus, by dividing a diseased stool or taking " spawn " or root cuttings from a diseased stool the disease is likely to be passed on in the roots to the new plantation.

It is therefore of great importance to select stools for propagation which are free or have shown no symptoms of these diseases. This selection cannot be carried out in the winter after leaf fall, but must be done as near before leaf fall as possible, when both diseases can easily be recognised by the leaf symptoms. Stools with only one cane showing leaf mottling or striping symptoms should be discarded for this purpose, and only stools quite clear from the symptoms used.

In the case of Raspberry Mosaic, it is known by experiment that if healthy stools are used for propagation the progeny stand a good chance of remaining healthy. Progeny from diseased stools, however, quickly develop symptoms of the disease.

An inspection of the plantation from which the new cane is going to be taken at a time when disease can be recognised is of primary importance, in order that disease stools may be avoided.

In the case of Cane Spot the disease is not seated in the rootstock, but in the bark of the canes. If, therefore, the canes bearing the spots are removed and burnt, an important source of infection of canes for the following year is removed. It is very important, however, that new cane for planting up should be as free as possible from the disease. In this case, cane can be selected after leaf fall, as badly infected canes are easily identified by the spots on the cane. It should be borne in mind that the minute white unsunken spots with the little black dots on them, may be as serious sources of infection as the more obvious pit cankers. In any case the fruiting canes should be cut down, as low as possible, immediately after planting, and the canes taken away and burnt.

(*b*) *Old Plantations.* Until more is known about the mode of spread of the Blue Stripe Wilt and " Mosaic " diseases, the control measures in established plantations that can be recommended must be regarded as tentative. In both these diseases it does appear from observation that badly infected stools are a source of danger to stools in the neighbourhood. Such stools should be grubbed and burnt on the first opportunity. The cutting out of canes killed by the Blue Stripe Wilt disease should be carried out as early as possible, e.g., when the old fruiting canes are cut out, and all such canes should be collected and burnt. This is a precaution against the resting stage of the fungus which develops in the bark of dead canes. These little black bodies can withstand considerable drying up and can germinate and give rise to the fungus which killed the cane.

The superficial growth of the Cane Spot fungus renders this disease more amenable to methods of direct control. In America it is claimed that spraying is effective as a control. Trials are now in progress at East Malling to ascertain whether spraying is also effective under our conditions. Meanwhile it is recommended that (1) fruiting canes should be removed and burnt as soon as possible after cropping, (2) all badly spotted canes should be cut out and burnt before the buds begin to shoot in the spring. This can conveniently be done in the late winter when the cane is thinned out.

A résumé of the chief symptoms of the three diseases mentioned is given in tabulated form as a key to help the grower to recognise the diseases at a glance.

Growers who are troubled with disease in raspberries and require further information on the best methods of dealing with them are asked to communicate with this Station.

Table Summarising the Chief Distinguishing Symptoms of the Three Diseases.

	Blue Stripe Wilt.	Cane Spot Disease.	"Mosaic" Disease.
Symptoms on :—			
1. LEAVES.			
a. *Fruiting Canes* ..	Withering starting at base of cane. Often leaves on one side only affected.	Small ringed spots usually in patches between main veins, also on petiole. In severe cases, downward curling and contortion of leaflets.	Yellow or light green mottling which may or may not be accompanied by downward curling, distortion and dwarfing.
b. *New Canes* ..	Withered stripe between main veins together with *upward* curling of edge of leaflets. Lowest leaves affected first and often leaves on one side of cane only.	As on leaves of fruiting canes.	As on leaves of fruiting canes.
2. STEM.			
a. *Fruiting Canes* ..	Discolouration of wood, only seen by cutting. Often only a strip is so affected the remainder being green. In spring non-developing buds seen, often confined to one side of cane.	White spots or sunken pits. In severe cases cane is very dwarfed the tip is dead, and the growth twisted.	In serious cases the cane is very dwarfed.
b. *New Canes.* ..	Dark blue stripe working up from soil level. Discolouration of wood as in fruiting canes.	Spots with purple margins which in severe cases run together and form cankers of irregular outline.	As on stem of fruiting canes.

FIG. 1.

A new cane of "Lloyd George" variety attacked by the "Blue Stripe Wilt" disease. The lower leaves have collapsed and show the striped discolouration characteristic of the disease. The upper leaves are still normal.

FIG. 2.

A new cane of "Semper Fidelis" variety attacked by the Cane Spot disease, photographed at the end of June and showing the dark ringed spots developing on the stem and leaf stalks. Spots are also just visible on the leaves which are downward curled

(a) FIG 3. (b)

Two new canes of "Superlative" variety. Cane (a) shows severe "mosaic" symptoms, i.e., mottling and curling of leaves. Cane (b) is nearly normal in appearance only showing "mosaic" symptoms very slightly.

Part IV

Entomology.

Part IV

ENTOMOLOGY.

1. Dormant Winter Wash Trials.

Tar Distillate Washes.

(*a*) In co-operation with Dr. Goodwin, of the S.E.A. College, the testing of some proprietary brands of tar distillate, together with similar washes of known constitution, has been continued both under field and laboratory conditions. Whilst all the washes used gave a significant measure of control—though not a complete one—over Hop Damson Aphis eggs, one wash did not prove injurious to caterpillar eggs, and none proved of the least avail against Red Spider eggs. Further, one of the washes of known constitution was tested in the Laboratory, upon Vapourer Moth Eggs, at strengths varying from 3 per cent. up to 20 per cent., with highly significant results.

Field Experiments with Egg Killing Washes.

(*b*) In co-operation with Messrs. F. Tattersfield and C. T. Gimingham, of the Dept. of Insecticides and Fungicides, Rothamsted Experiment Station, a new series of winter washes was tested in the field for their egg-killing properties. Whilst some of the washes used gave completely negative results, others showed a 70 to 80 per cent. effectiveness against the Hop Damson Aphis, but again proved useless against Red Spider.

In conjunction with the trials of these washes, methods were tested for measuring more accurately under field conditions the effects of different sprays, and the natural mortality. The season proved an exceptionally favourable one for such work and considerably advanced our knowledge in conducting such trials.

2. Study of Resistance of Different Varieties to Certain Insect Attacks.

The Permanent Apple Aphis (*Aphis Pomi* de Geer).

(*a*) The work upon the resistance of Apple Stocks to *Aphis pomi* De Geer has been continued upon a number of seedlings of known origin. After continued direct infections, about 5 per cent. have been selected as showing very marked resistance. It remains to be seen whether the progeny from these plants maintains the resistance, and, also, whether they show a similar resistance to other insect attack, such as Woolly Aphis (*Eriosoma lanigerum*).

The Cherry Black Fly (*Myzus cerasi* F.).

(*b*) This work has been extended to a study of the resistance of certain selected Mazzard Cherry Stocks (*P. avium*) to Cherry Aphis (*Myzus cerasi*), since for the past five seasons marked differences have been apparent.

3. Woolly Aphis and a Study of Varietal Susceptibility Thereto.

During the past season this work has been revised and extended, and material worked up for its development. The most encouraging feature up to the present has been the marked resistance to attack of certain seedlings (raised by M. B. Crane, of the John Innes Horticultural Institute), with the Northern Spy as one parent. Combinations of susceptible scions and immune roots, and vice versa, have given interesting results.

4. Systematic Study of Gall Mites.

A systematic study of the Eriophyidæ has been undertaken and up to date over thirty species, hitherto only recognised by the galls in this country, have been identified from the characters of the mites themselves. Two new species, hitherto unrecognised, have been found on the Black Currant, and two others, on the Nut and on Timothy grass, have been described for the first time as being found in this country.

The life histories of those species likely to be of economic importance are being followed up.

(*a*) *Black Currant Gall Mite* (*Eriophyes ribis* Westw., Nal.).

The details of the life history of the black currant gall mite, revealing certain fresh features, have been confirmed this season, and a report is now in preparation.

(*b*) *Control of "Black Currant Gall Mite" in the Field.*

A fifth season's records show still more strikingly the effective control of "big bud" obtained, under our conditions, by spraying with winter strength Lime Sulphur (1.025 s.g.) just before the first blossoms open. There is some evidence to show that the time of spraying is of great importance. A report, in conjunction with the Pomological Department, has been published.

Various other sulphur washes, at different strengths and times, have been tested for one season in field and laboratory.

For the effect of this Control upon "Reversion" see paragraph dealing with same.

(*c*) *Susceptibility of Black Currant Seedlings to Mite Attack.*

A series of seedlings of parentage Seabrook "selfed" (raised by the Pomological Department) have now been subjected to direct mite infection for three seasons. Although no individuals show complete immunity to attack, a few show considerable resistance, and do not develop the normal big buds.

5. Investigation into Causes, Transmission and Control of "Reversion."

This study has been continued in collaboration with the Pomological and Physiological sections. Once the transmissibility of "reversion" by grafting methods, etc., had been proved, it became of first hand importance to discover the natural agents of transmission.

From 1921 onwards series of healthy black currant seedlings have been subjected to direct infections with bud mite (*Eriophyes ribis*). The evidence now accumulated is overwhelmingly in favour of the theory that this mite is a cause of transmission. Whether the other species of mite, only recently recognised, are also causes of transmission remains to be proved. Work on these lines has begun.

In the field, the Lime Sulphur Spray, which controls the Bud Mite, is now found to be controlling the spread of "Reversion," thus confirming the above results.

Finally, by raising clones from selected bushes we have succeeded in obtaining cutting beds wholly free from "Reversion."

After four years careful "roguing" and lime sulphuring in the plantations generally, our cutting beds have failed to reveal a single case of "reversion" this season. A simple method for distinguishing true and "false" Reversion has been established.

6. Raspberry "Mosaic."

The various insects and mites found on the cultivated raspberry are being collected with a view to studying the possible causes of transmission of these diseases. See also Pathological Section.

THE CONTROL OF THE BLACK CURRANT GALL MITE.

(*Eriophyes ribis* Westw., Nalepa.)

By A. M. MASSEE.

The disease caused by this mite popularly known as "Big Bud," was first brought to the notice of fruit growers in this country round about the years 1849-1850. There are a few earlier records of the existence of this pest, but they are very vague, and appear to be of little importance.

In 1850 the Black Currant Gall Mite was recorded from at least three widely separated parts of Britain, namely, in the Maidstone district, from Yorkshire, and in Scotland. It seems evident, therefore, that this mite must have been established long before this period, otherwise it would not have been recorded as a serious pest to currants at that early date.

From the middle of the nineteenth century onwards the mite has gradually spread from one district to another, until it has established itself in almost every part of Great Britain.

The rapid spread of this mite during the past seventy-five years is readily accounted for. In the first place, there is little doubt that the mites have been carried far and wide on young currant bushes, which have been propagated in young nursery beds, and then despatched to various parts of the country. This seems to have been one of the chief agents for distributing the mites in latter years.

It must be remembered also that there is a natural migration of the mites during the spring months, and during this period some of the bud mites establish themselves in new quarters which have hitherto been free of the pest.

Again, during the migration period, when the mites emerge from the old enlarged "big buds," they are carried by the winds, as well as various species of insects, such as the Currant Greenfly and Ladybirds, from bush to bush. These migratory habits all help in disseminating the pest from bush to bush, and from one plantation to another.

Finally, it has been shown that it is not necessary to have large numbers of infested bushes introduced into a plantation in order to spread the disease, for it is known that only one or two diseased bushes will in time infest all currants growing in the vicinity. For example, one diseased bush, planted in close proximity to healthy plants has been shown to be sufficient to infest all the bushes round about in the short period of four years.

Methods of Control.

Many research workers have been engaged in the problem of controlling the Black Currant Gall Mite, and in consequence various methods of control have been advocated. It is of interest to refer to a few of the most important of these treatments.

Hand Picking.

It has been a general practice for some years for growers to examine each bush carefully, during the winter, when they are being pruned, and remove all the obvious " big buds." Commercially these diseased buds are collected in bags, the contents of which are destroyed at the end of the day's work.

This methodical removal of " big buds " tends to keep the pest in check to some small extent, but it has been noticed repeatedly that the bud mites always appear again the following year in a plantation so treated. The reason for the reappearance of the disease can be accounted for as follows.

The hand picking of galled buds is usually carried out during November and December (*at the same time as pruning*), and the one picking is generally considered sufficient to keep the mites in check. However, it is now well known that many buds which appear normal during November and December develop into " big buds " at a later date. For instance, " big buds " appear in some seasons during January, February, and even March. Several plantations have been noticed in which " big buds " are prevalent during the spring months, in spite of the fact that systematic hand picking was undertaken during the autumn.

Also it has been ascertained that a small percentage of buds may be infested with Gall Mites, without developing into the well-known typical " big bud." These buds appear quite healthy externally, and the mites can only be discovered by dissecting the buds and examining them under a microscope. This makes it quite clear, therefore, that when hand picking is undertaken to eradicate the mites, all the unswollen buds which contain mites are overlooked ; it is such buds as these which harbour the disease and account for its presence the next season. This also would account for unwitting distribution of mite by fresh raisers.

Method of Cutting down Bushes to Eradicate Mites.

In plantations in which the mites have increased to such an extent as to cause a wholesale infection of the bushes, the method of cutting down the bushes to ground level has been introduced. In practice it is usual for growers to plant the currant bushes close together in the rows, and to cut down one half of the bushes in one year, and then treat the remaining plants in a similar manner the following winter.

In many parts of Kent growers cut down the bushes in alternate years with the object of obtaining fresh supplies of young uninfected wood.

This method has several disadvantages. In the first place, only half the bushes are cropping in any one year. Again, a control of the mite is only possible on half the bushes in the plantation in one season, but closer planting to some extent makes up, if that method alone is relied on. It has also been shown very definitely that by cutting the bushes down to ground level the mites are not entirely stamped out. Many of the buds round the stump of the bush contain mites, which carry on the infection to the newly forming wood.

Another source of infection is also ready at hand. The uncut bushes are practically always " big budded," and the mites migrate from these to the cut down bushes during the spring. It is interesting to note that " big buds " are always found clustered round the collar of the bush after receiving the drastic treatment of being cut down to ground level.

In a small experiment conducted at East Malling, the stumps of a number of bushes, which had been cut down to ground level during the winter, were thoroughly sprayed with lime-sulphur (one in twelve, specific gravity 1.025) on 30th March, 1925. Later observations showed that considerably less " big bud " developed on the bushes so treated. This indicates that the application of lime-sulphur to the stumps of the cut-down bushes in the spring, gives a greater measure of mite control than the usual method of simply cutting down the bushes and leaving them untouched throughout the spring and summer months.

Application of Lime-Sulphur Sprays.

The effectiveness of Lime-Sulphur against the Black Currant Gall Mite has been investigated at East Malling from 1921 onwards. The full results of this work have been published in the Annual Report of the East Malling Research Station for 1924. These results have shown very clearly under our conditions, that Lime-Sulphur applied at the proper season and at the correct strength is far superior to any other method of control tested in the past.

The use of Lime-Sulphur for the control of the Black Currant Gall Mite was first tried by Mr. A. H. Lees.* Lees found that a partial control of this pest was obtained by applying Lime-Sulphur (concentration of one to twelve, specific gravity 1.025) to the bushes in the spring when " the leaves are the size of a sixpence," but under his conditions the control was not sufficient to warrant its continuance.

This method of control has been followed up and so adapted to our conditions as to give highly satisfactory results.

In the course of the work it has been found that it is necessary to apply the Lime-Sulphur to the bushes in the spring, when the mites are beginning to migrate

* Annual Report, Agricultural and Horticultural Research Station, Long Ashton, 1919.

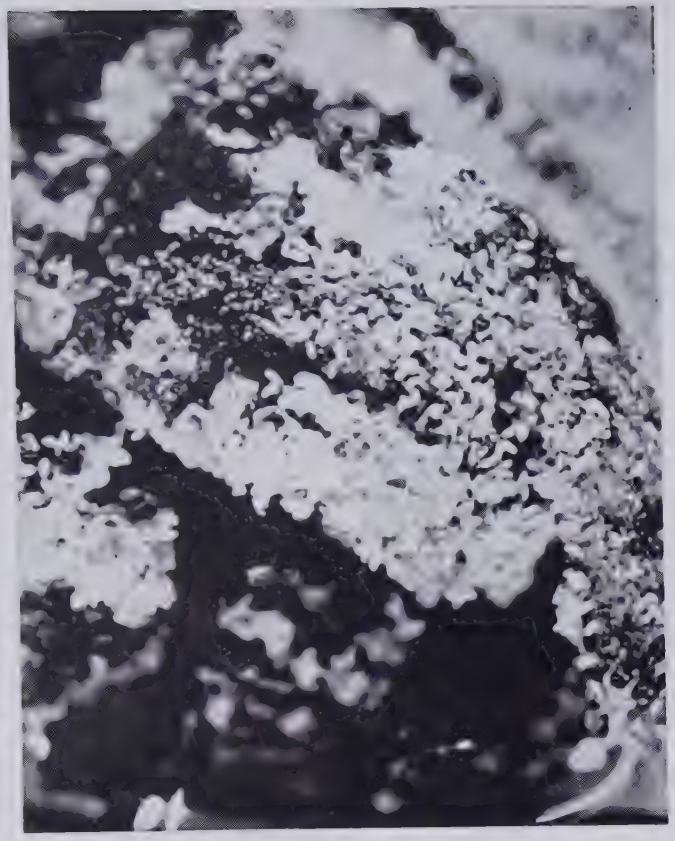


Fig. A

Black Currant Gall Mites (*Eriophyes ribis* Westw., Nal.) killed by Lime-Sulphur Spray.

Fig. B.

Black Currant Gall Mites (*Eriophyes ribis* Westw., Nal.) migrating from unsprayed "Big Bud."

FIG. C.

A shoot of Baldwin Black. Showing the period at which the Lime-Sulphur spray should be applied to the bushes.

from the " big buds." Further it has been demonstrated that the Lime-Sulphur does not actually kill the mites which are living in the diseased buds. On the contrary, they appear to live normally until they commence to migrate. During the migration period they invariably feed on the old bud before leaving it, and in doing so they come in contact with the residue of the Lime-Sulphur, which kills them. Mites have been observed to live as long as one month in buds which have been sprayed with Lime-Sulphur, but as soon as they begin to leave the buds they are killed.

Microscopical examinations of " big buds " after Lime-Sulphur treatment reveal the presence of thousands of dead mites still attached to the outer bud scales. This phenomenon appears to be general on sprayed bushes. *Figure A* illustrates a typical " big bud," sprayed with Lime-Sulphur, on which masses of dead mites are seen. Compare *Figure B*, which shows the mites normally migrating from an unsprayed bud.

It is now well known that the mites remain on the bushes when they emerge from the old galled buds. As a matter of fact, mites can be found on the leaves, etc., until they enter the new buds several weeks later.

It is evident, therefore, that if the bushes have been thoroughly well covered with the spray, many of the mites living freely on the leaves will be destroyed.

The above remarks indicate how necessary it is to know exactly when to put on the spray. The time of application seems to be the secret of success.

It is not possible to make a hard and fast rule, giving exact dates, as to when the spray should be applied. *First,* on account of the bushes coming into leaf earlier some seasons than others. *Second*, individual varieties of currants such as Baldwin and Goliath have very different habits, for example, Baldwin is much earlier coming into leaf than Goliath. Thus it will be seen that these two varieties cannot be sprayed equally effectively at the same period.

The actual date of spraying on the experimental plot at East Malling during the years 1922, 1923 and 1924 was on March 28th, March 22nd and April 12th respectively. It can be reasonably stated that the spraying of early varieties should be carried out some time between the middle of March until the latter part of April, depending as already mentioned on the particular season in question.

Optimum Time for Spring Spraying.

It is quite an easy matter to judge the best time for putting on the spray. For this purpose a survey of the bushes should be made during the spring when the leaves are developing and the flowers are forming. As soon as the flower racemes are noticed to appear, but before the flowers open, is the correct time to apply the spray. It is important to remember that the currants should be

sprayed when the flower racemes appear, but before the flowers open, otherwise slight damage is likely to result.

Illustration C represents a flowering currant shoot showing the critical stage at which the lime-sulphur spray should be applied.

Strength of Spray.

The Lime-Sulphur should be applied to the bushes at approximately a strength of one in twelve (specific gravity 1.025), e.g., in other words, one part of Lime-Sulphur to eleven parts of water.

Spray Damage.

After the application of a Lime-Sulphur spray, some scorching of the young leaves almost always results, and as a rule the whole bush appears to look somewhat yellowish, for some weeks afterwards. This, however, is only temporary and our bushes have suffered no appreciable damage to growth or crop.

Small abortive undeveloped flowers which are numerous in some seasons, have been mistaken by some growers for Lime-Sulphur damage. These abortive flowers can be found just as commonly on unsprayed bushes. It is evident, therefore, that Lime-Sulphur is not responsible.

Finally, the actual cost of Lime-Sulphur spraying has been worked out, and it is estimated, taking every expense into consideration, that it costs a little less than one penny per bush, or, at 1,210 bushes per acre, £4 10s. 9d.

Owing to the measure of control obtained by using Lime-Sulphur and the greater length of life it gives to the bushes—the cost of application is fully justified.

Summary.

Experimental work at East Malling clearly shows that the application of a Lime-Sulphur spray to currant bushes in the spring, when the flower racemes appear, but before the flowers open, is the most effective method of controlling the Black Currant Gall Mite yet tried.

The spray should be used at a concentration of approximately one in twelve (specific gravity 1.025).

Permanent damage does not result from using the Lime-Sulphur at the high concentration of one in twelve, but there is evidence of slight temporary damage, which, however, has not been detrimental to the bush.

Part V.

Hops.

Part V.

HOPS.

The Testing of New Varieties.

The testing of new varieties raised by Professor E. S. Salmon, of the S.E.A. College, Wye, against commercial sorts has been continued, and the outstanding value of some of his introductions maintained.

The Manurial Trials.

These trials are still being continued, but so far the crop weights have been too variable to show any consistent significant differences.

Part VI.

Field Trials.

Part VI.

FIELD TRIALS.

During the past year some eight acres have again been used for Field Trials. For the fourth year in succession the trial of Winter Oats was continued, three acres being sown with four varieties. As in 1924 each was sown in plots of two drill widths, each variety being actually repeated nine times.

Two acres of Winter Wheat was also grown, five varieties in all, three of which have been now tested over four seasons, and two over two seasons. Each variety was duplicated four times.

The remaining three acres was cropped with British Queen Potatoes for the continuance of the spraying trials which have now been carried out over a period of eight years. One other crop was added to our trials, that of Winter-sown Broad Beans, some three acres of land under standard plums being interplanted. Some nine different varieties were obtained from various sources, the idea being to test their cropping capabilities, and to see what differences, if any, were due to source of seed.

Part VII.

Meteorological Observations.

Part VII.

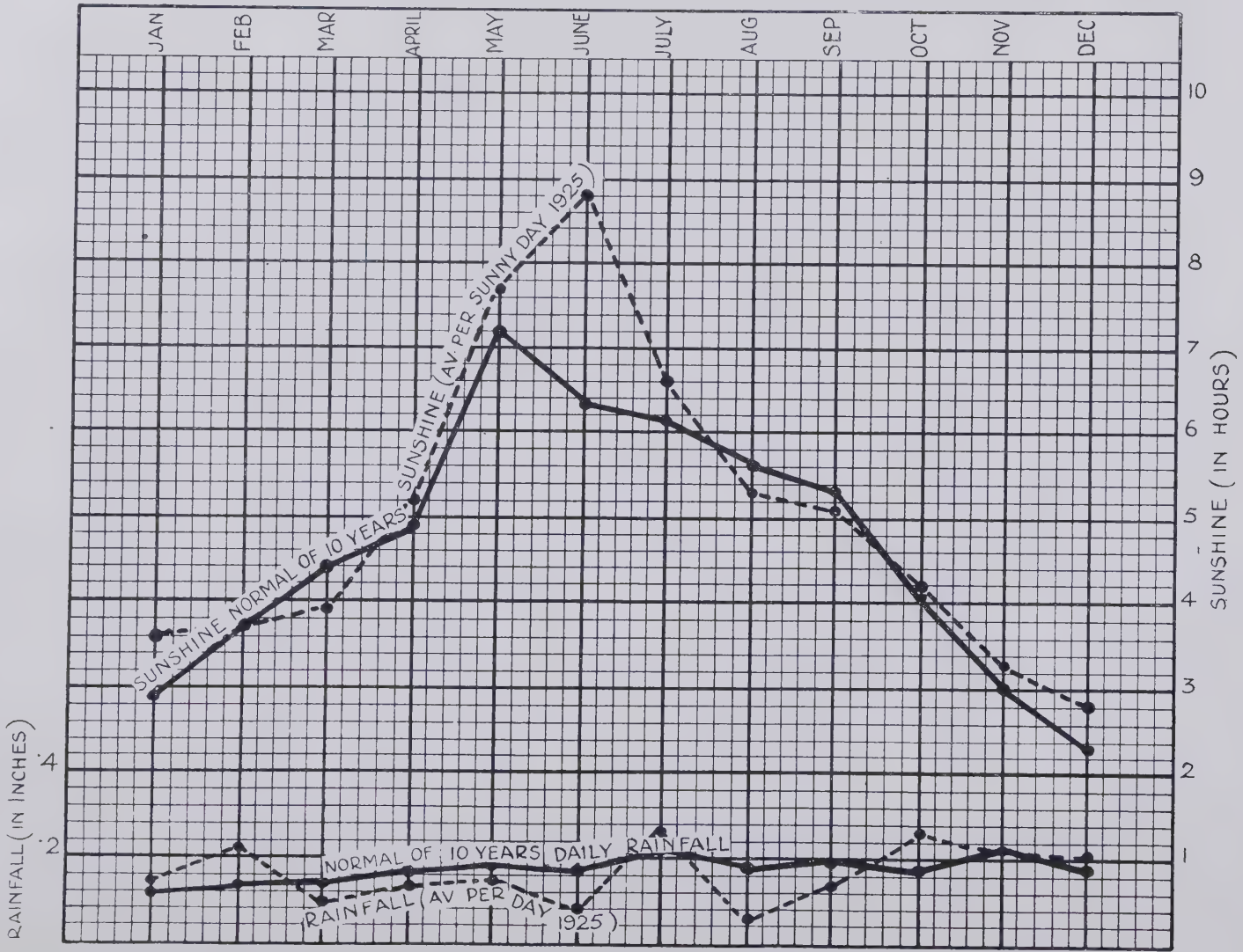
METEOROLOGICAL OBSERVATIONS.

By H. M. Tydeman and H. C. Chapelow.

Weather Conditions during 1925.

The weather experienced at this Station during the past year may be said to have been extremely typical. Both rainfall and sunshine show a marked approximation to the normal, and deviate only in respect of the exceptional sunniness and drought conditions of June and the dryness of August. The total rainfall for the year was 26.89 inches ; only two inches in excess of our ten years' average. It was well distributed throughout the year, falling in greatest abundance in October and July, the latter month being characterised by severe depressions and storms. The year's total sunshine was 1,584.5 hours, just 196 hours in excess of the average. With the exception of June, a notably sunny month, the sequence of sunshine has shown a surprising conformity to the normal. With reference to temperatures, it may be said that while the summer months were slightly warmer than usual, the extremes of the year, spring and autumn were somewhat more severe. In general, however, marked aberrations from the average values were very rare, and occurred only in the case of the exceptionally low mean temperatures of March, September and December. The autumn in particular was unusually severe in respect of low night temperatures, September, in many years free from ground frosts, having no fewer than eight, while both October and November had more than usual.

Table showing SUNSHINE & RAINFALL during 1925 (Average per sunny or rainy day) compared with previous TEN YEAR Average.



SUMMARY OF METEOROLOGICAL OBSERVATIONS DURING 1925.

	Barometer.	Temperature in Screen.					On Grass.		No. of Frosts.	Rainfall.				Sunshine.			Hygrometers.			Wind.
	Mean Reading.	Mean maximum.	Mean minimum.	Highest.	Lowest.	Mean.	Mean.	Lowest.		Total (ins.)	No. of days.	Av. per rainy day.	Heaviest fall in a day.	Total hours.	No. of sunny days.	Av. per sunny day.	Mean of dry bulb.	Av. deprec. of wet bulb.	Av. humidity. %	Direction.
January ..	30.207	47.4	35.4	54	24	41.4	32.6	20	11	1.99	13	0.15	0.54	47.3	13	3.6	39.8	1.2	89	S. & S.W.
February ..	29.626	47.8	32.0	55	25	39.9	30.8	20	12	3.27	14	0.23	0.86	77.7	21	3.7	41.7	1.7	85	S.W.
March	30.085	47.0	34.3	55	26	40.6	30.9	22	16	0.88	9	0.09	0.21	94.5	24	3.9	40.8	1.8	84	N. & N.E.
April	29.779	53.6	38.8	61	29	46.2	34.0	22	8	2.01	16	0.13	0.30	146.5	28	5.2	47.9	3.5	74	N., N.E. & N.W.
May	29.738	64.3	45.0	79	36	54.6	40.1	27	1	2.01	13	0.15	0.42	232.8	30	7.7	55.8	3.8	76	S. & S.W
June	30.057	69.7	48.0	84	39	58.8	41.4	28	2	0.28	4	0.07	0.24	256.9	29	8.8	61.7	5.5	69	N.
July	29.890	72.6	52.9	85	45	62.7	42.3	33	0	3.45	13	0.26	0.93	191.8	29	6.6	64.4	4.4	76	S.W.
August ..	29.912	68.7	52.4	79	44	60.5	46.3	37	0	1.79	13	0.06	0.36	163.6	29	5.3	62.5	3.4	81	S.W.
September ..	29.901	61.6	45.2	78	34	53.4	36.8	26	8	1.80	14	0.13	0.36	132.7	26	5.1	54.7	2.8	81	W.
October ..	29.880	59.5	43.3	72	29	51.4	36.9	19	11	3.55	14	0.25	0.84	109.3	26	4.2	51.5	1.5	90	SW
November ..	29.853	45.6	35.2	60	22	40.4	26.2	15	21	2.85	13	0.22	0.64	74.9	23	3.3	40.4	1.2	89	N. & N.E.
December ..	29.679	43.0	32.6	55	16	37.8	27.2	9	17	3.01	15	0.20	0.52	56.5	20	2.8	37.7	1.1	90	W. & S.W.

LIST OF PUBLISHED REPORTS TO 31ST DECEMBER, 1925.

To be obtained from:—THE SECRETARY, EAST MALLING RESEARCH STATION, EAST MALLING, KENT.

N.B.—The reports issued during 1925 are indicated by an asterisk(*).

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	POMOLOGY.		
	Top Fruits.		
	Root Stocks.		
E1.	Paradise Apple Stocks. By R. G. Hatton.	Journal of Royal Horticultural Society, Vol. xlii., Part 2 and 3, p. 361, September, 1917.	
E2.	Paradise Apple Stocks. Their Fruit and Blossom described. By R. G. Hatton.	Ditto, Vol. xliv., p. 89, May, 1919.	
E4.	Suggestions for the Right Selection of Apple Stocks. By R. G. Hatton.	Journal of Royal Horticultural Society, Vol. xlv., Parts 2 and 3, p. 257, July, 1920.	
E5.	A First Report on Quince Stocks for Pears. By R. G. Hatton.	Journal of Royal Horticultural Society, Vol. xlv., Parts 2 and 3, p. 269, July, 1920.	
E9.	Results of Researches on Fruit Tree Stocks. By R. G. Hatton.	Journal of Pomology, Vol. ii., No. 1, pp. 1-10, November 1920.	
E6.	Stocks for the Stone Fruits. By R. G. Hatton.	Journal of Pomology, Vo. lii., No. 4, pp. 209-245, August, 1921.	Price 1s. 6d., postage 3d.
E8.	The Importance of Suitable Stocks in Planting Young Fruit Trees. By R. G. Hatton.	Journal of the Kent Farmer's Union, Vol. x., No. 3, p. 82, September, 1921.	
E10.	The Influence of Root Stock upon the Tree Fruits. By R. G. Hatton.	Fruit Grower, Vol. xvi., No. 1455, pp. 639-641; No. 1456, pp. 609-700; No. 1457, pp. 759-760; 18th and 25th October, 1923, and 1st November, 1923. Verslag Van Het International Tuinvouw-Congress, Amsterdam, 17th-23rd September, 1923, pp. 94-117.	Price 6d., postage 2d.
E7.	Some Notes on Stocks for Plums. By R. G. Hatton.	Journal of the Kent Farmers' Union, Vol. xiv., No. 5, p. 158, November, 1923.	
*E11.	Cherry Stocks; their Behaviour in the Nursery. By N. H. Grubb and A. W. Witt.	Annual Report of the East Malling Research Station, 1924, pp. 87-92.	
E12.	The Choice of Young Fruit Trees. By R. G. Hatton, J. Amos and N. H. Grubb.	Journal of the Kent Farmers' Union, Vol. xvi., No. 4, pp. 132-134, October, 1924, and Annual Report of the East Malling Research Station, 1924, pp. 93-100.	Price 2d., postage 1d.

	TITLE.	JOURNAL OF PUFLICATION.	REPRINTS.
	Propagation.		
E3.	Summary of the Results obtained in Selection and Propagating Paradise Stocks. By R. G. Hatton.	The Fruit Grower, Vol. xlvii., pp. 1211-1212, February, 1919; Fruit Trades' Journal, Vol. xxxv., Nos. 7, 8, 9, February, 1919; Gardeners' Chronicle, Vol. lxv., Nos. 1677, 1678, 1679, pp. 71, 82, 100, February and March, 1919.	
E13.	Some Problems of Propagation, Part I. By R. G. Hatton, J. Amos and A. W. Witt.	Annual Report of the East Malling Research Station, 1923, pp. 100-109.	
	Pruning.		
EP1.	Results of Apple Pruning Experiments. By N. H. Grubb.	Journal of the Kent Farmers' Union, Vol. x., No. 4, p. 114, October, 1921.	Price 3d., postage 1d.
EP2.	Winter Pruning Experiments with Apple Trees. By N. H. Grubb.	Journal of Royal Horticultural Society, Vol. xlvii., Parts 2 and 3, p. 139, September, 1922.	Price 6d., postage 2d.
EP3.	Notes on Apple Pruning. By N. H. Grubb.	Journal of the Kent Farmers' Union, Vol. xiii., No. 3, p. 95, March, 1923.	Price 3d., postage 1d.
*EP4.	Apple Pruning. Summary of Deductions from Experiments at East Malling. By N. H. Grubb.	Journal of the Kent Farmers' Union, Vol. xviii., No. 5, pp. 150-154, November, 1925.	Price 2d.
	Miscellaneous.		
E15.	Some Factors Influencing Root Development. By R. G. Hatton, N. H. Grubb and J. Amos.	Annual Report of the East Malling Research Station, 1923, pp. 110-119.	
*E14.	Field Observations on the Incidence of Leaf Scorch upon the Apple. By R. G. Hatton and N. H. Grubb.	Journal of Pomology and Horticultural Science, Vol. iv., No. 2, pp. 65-77, January, 1925. Annual Report of the East Malling Research Station, 1924, pp. 41-53.	Price 6d.
*E16.	Some Factors Influencing the Period of Blossoming of Apples and Plums. By R. G. Hatton and N. H. Grubb.	Annual Report of the East Malling Research Station, 1924, pp. 81-86.	Price 6d., postage 2d.
	Small Fruits.		
Esf.1.	Black Currant Varieties—A Method of Classification. By R. G. Hatton.	Journal of Pomology, Vol. i., Nos. 2 and 3, pp. 68-80, 145-154, 1920.	
Esf.2.	The "Running-Off" of Black Currants. By R. Wellington, R. G. Hatton and J. Amos.	Ditto, Vol. ii., No. 3, pp. 160-198, May, 1921.	

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
*Esf.5.	Black Currant Variety Trials: Reliability of Results. By R. G. Hatton, N. H. Grubb and R. C. Knight.	Journal of Pomology and Horticultural Science, Vol. iv., Nos. 3 and 4, pp. 200-220, June, 1925.	Price 6d.
Esf.3.	Commercial Raspberries and Their Classification. By N. H. Grubb.	Journal of Pomology and Horticultural Science, Vol. iii., No. 1, pp. 11-35, November, 1922.	Price 7d., postage 3d.
Esf.4.*a*	A Note on the Impurity of Raspberry Stocks. By N. H. Grubb and G. S. Peren.	Ditto, Vol. iii., No. 1, pp. 7-10, November, 1922.	
Esf.6.	Raspberry Investigations. By N. H. Grubb.	Annual Report of the East Malling Research Station, 1923, pp. 128-130.	
*Esf.7.	Raspberry Varieties and Their Cropping. By N. H. Grubb.	Ditto. 1924, pp. 75-80.	Price 2d., postage 1d.
	PHYSIOLOGY.		
F1.	The Carbohydrate-Nitrogen Ratio. By R. C. Knight.	Science Progress. Vol. xix., pp. 34-42, 1924.	
	PATHOLOGY.		
C1.	Tests of Fungicides on Apple Trees. By N. H. Grubb.	Journal of Pomology, Vol. ii., No. 2, pp. 93-114, February, 1921.	
C5.	Tests of Fungicides on Apple Trees—II. By N. H. Grubb.	Ditto, Vol. iii., No. 4, pp. 157-173, January, 1924.	
C6.	Fungicidal Spraying of Apples. By N. H. Grubb and N. B. Bagenal.	Annual Report of the East Malling Research Station, 1923, pp. 120-124.	
C7.	Experiences with Fungicidal Sprays. By N. H. Grubb.	Journal of the Kent Farmers' Union, Vol. ix., No. 5, p. 147, May, 1921.	
C8.	The Spraying of Apples. By N. H. Grubb.	Gardeners' Chronicle, Vol. lxx., No. 1826, p. 326, December, 1921.	
C3.	The Crown Gall Disease of Nursery Stocks—I. Field Observations on Apple Stocks. By H. Wormald and N. H. Grubb.	Annals of Applied Biology, Vol. XI, Nos. 3 and 4, pp. 278-291, October, 1924.	
C9.	Notes on the Control of Nursery Stock against Crown Gall. By H. Wormald and N. H. Grubb.	Gardeners' Chronicle, Vol. lxxi., No. 1843, p. 198, April, 1922.	
*C17.	Field Observations on the Crown Gall of Nursery Stocks. By H. Wormald and N. H. Grubb.	Annual Report of the East Malling Research Station, 1924, pp. 122-125.	See 14.
*C4.	The Blue Stripe Wilt of the Raspberry. By R. V. Harris.	Journal of Pomology and Horticultural Science, Vol. iv., Nos. 3 and 4, pp. 221-229, June, 1925, and Annual Report of the East Malling Research Station, 1924, pp.126-134.	Price 6d. See 14.

a Joint Publication with Long Ashton Research Station.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
C10.	Raspberry " Mosaic." By N. H. Grubb and A. M. Massee.	Annual Report of the East Malling Research Station, 1923, pp. 131-133.	
C2.	†The Mulberry Blight in Britain. By H. Wormald.	Annals of Applied Biology, Vol. xi., No. 2, pp. 169-174, July, 1924.	
*C16.	Mulberry Bacterial " Blight." By H. Wormald.	Annual Report of the East Malling Research Station, 1924, pp. 120-121.	See 14.
*C18.	An Unusual Form of Pear Canker. By R. V. Harris.	Ditto, 1924, pp. 135-136.	
*C11	Note on the Bacterial Soft Rot of Turnips. By H. Wormald and R. V. Harris.	Annals of Applied Biology, Vol. xii., No. 3, pp. 326-329, July, 1925.	See 14.
*C15.	Notes on Plant Diseases in 1924. By H. Wormald.	Annual Report of the East Malling Research Station, 1924, pp. 110-119.	See 14.
	For Potato Spraying. See Field Trials.		
*C12.	Parasitic Fungi of Cereals. By H. Wormald.	Farm Crops, Vol. I., pp. 318-336, 1925.	
C14.	Plant Pathology Section. By W. Hormald.	Annual Report of the East Malling Research Station, 1924, pp. 107-136.	Price 5d., postage 2d.
*C13.	A Leaf Blotch of the Shasta Daisy. By H. Wormald.	The Gardeners' Chronicle, Vol. lxxviii., No. 2,027, Oct. 31st, 1925, p. 353.	
C.19.	On the occurrence in Britain of the Conidial Stage of Sclerotinia Cydoniæ Schell. By H. Wormald.	Transactions of the British Mycological Society, Vol. X, Part IV. 25th February, 1926.	
	ENTOMOLOGY.		
D1.	The Control of the Apple Blossom Weevil. By A. M. Massee.	Journal of Pomology, Vol. iv., No. 1, pp. 24-37, July, 1924.	Price 5d.
D2.	Control of Apple Blossom Weevil. By R. G. Hatton.	Journal of the Kent Farmers' Union, Vol. ix., No. 6, p. 176, June, 1921.	
D3.	Apple Blossom Weevil Experiments. By K. P. Worsley.	Journal of the Kent Farmers' Union, Vol. xii., No. 1, p. 30, July, 1922.	
D4.	The Resistance of Apple Stocks to Attacks of the Green Apple Aphis. By A. M. Massee.	Journal of Pomology, Vol. iii., No. 4, pp. 191-200, January, 1924.	
D5.	The Control of Big Bud Mite in the Field. By H. M. Tydeman.	Annual Report of the East Malling Research Station, 1923, pp. 125-127.	
*D6.	The Control of the Big Bud Mite in the Field. By R. G. Hatton, J. Amos and H. M. Tydeman.	Annual Report of the East Malling Research Station 1924, pp. 158-160.	Price 2d., postage 1d.
D7.	The Leaf and Bud Mite of Raspberry. By A. M. Massee.	Journal of Pomology, Vol. iv., No. 1, pp. 59-61, July, 1924.	
D8.	Abnormal Leaves of the Himalaya Berry and the Raspberry. By A. M. Massee.	The Gardeners' Chronicle, Vol. lxxii., No. 1872, p. 281. November 11th, 1922.	

†This Report was mainly the result of an investigation carried out at the S.E.A. College, Wye, and completed after Dr. Wormald's appointment at East Malling.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	Raspberry " Mosaic " (see Pathology Section.)	Annual Report of the East Malling Research Station, 1924, pp. 143-144.	
*D9.	Preliminary Field Trials of Tar Distillate Washes. By A. M. Massee.		
	HOPS.		
B1.	First Report on Trial of New Varieties of Hops at East Malling. By Prof. E. S. Salmon.	The Research and Advisory Dept., S.E.A. College, Wye, January, 1918.	
B2.	Second Ditto. By Prof. E. S. Salmon.	Ditto, April, 1919.	
B3.	Third Ditto. By Prof. E. S. Salmon.	Ditto, April, 1920.	Price 6d., postage 2d.
B4.	Fourth Ditto. By Prof. E. S. Salmon.	East Malling Research Station, Kent, July, 1921.	Ditto.
B5.	Fifth Ditto. By Prof. E. S. Salmon.	Ditto, July, 1922.	Ditto.
B6.	Sixth Ditto. By Prof. E. S. Salmon.	Ditto, July, 1923.	Ditto.
B7.	Seventh Ditto. By Prof. E. S. Salmon.	Ditto, June, 1924.	Ditto.
*B8.	‡Eighth Ditto. By Prof. E. S. Salmon.	Ditto, August, 1925.	Ditto.
*B9.	Hop Experiments: The Testing of New Varieties of Hops. By R. G. Hatton and J. Amos.	Annual Report of the East Malling Research Station, 1924, pp. 169-175.	
*B10.	Manurial Scheme of Trials with Hops. By J. Amos.	Ditto, 1924, pp. 176-179.	
	FIELD TRIALS.		
	Potatoes.		
G1.	Trial of Wart Resistant Potatoes. By R. G. Hatton and J. Amos.	Journal of the Kent Farmers' Union, Vol. vi., No. 5, p. 103, November, 1919.	
G2.	Variety Trials with Potatoes, 1919-20. By R. G. Hatton.	Ditto, Vol. ix., No. 1, p. 21, January, 1921.	
G3.	Ditto, 1921 By J. Amos.	Dittto, Vol. xi., No. 1, p. 20, January, 1922.	
G4.	Potato Trials at East Malling Research Station, 1923. By R. G. Hatton and J. Amos.	Journal of the Kent Farmers' Union, Vol. xiv., No. 5, p. 166, November, 1923.	
G5.	Potato Trials at East Malling Research Station, 1924. By R. G. Hatton and J. Amos.	Ditto, Vol. xvi., No. 5, p. 167, No. 6, p. 213, November, ane December, 1924, and Annual Report of the East Malling Research Station, 1924, pp. 189-194.	
G6.	Spraying Trials with Potatoes, 1918. By Prof. E. S. Salmon and H. Wormald.	Journal of the Board of Agriculture, Vol. xxvi., No. 1, p. 71, April, 1919.	
G7.	Potato Spraying. " Three Years' Results at East Malling Research Station." By R. G. Hatton.	Journal of the Kent Farmers' Union, Vol. x., No. 1, p. 8, July, 1921.	
	Corn.		
G8.	Variety Trials with Oats and Barley. Spring, 1920. By R. G. Hatton.	Journal of the Kent Farmers' Union, Vol. viii., No. 6, p. 148, December, 1920.	

‡Reports issued from East Malling by Prof. E. S. Salmon, S.E.A. College, Wye, on data collected jointly upon Hops grown at East Malling.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
G9.	Wheat Trials at East Malling, 1921. By J. Amos.	Ditto, Vol. x., No. 3, p. 91, September, 1921.	
G10.	Winter Corn Trials (Wheat and Oats). 1921-22. By J. Amos.	Ditto, Vol. xii., No. 5, p. 164, November, 1922.	
G11.	Winter Oat Trials, 1922-23. By J. Amos.	Ditto, Vol. xiv., No. 5, p. 165, November, 1923.	
G12.	Corn Trials, 1923-24. By R. G. Hatton and J. Amos.	Ditto, Vol. xvi., No. 3, p. 93, September, 1924.	
*G13.	Runner Bean Trials. 1924. By H. C. Chapelow.	Annual Report of the East Malling Research Station, 1924, pp. 195-203.	
	METEOROLOGY.		
H.	Meteorological Observations.	Contributed monthly to the Kent Farmers' Union Journal.	
*H2.	Weather Conditions during 1024. By H. M. Tydeman.	Annual, Report of the East Malling Research Station, 1924 p. 204.	
	ANNUAL REPORTS.		
A1.	,, ,, 1920. In 1914, 15, 16.	Brief leaflets outlining initiation of experiments, etc., were published as from " Wye College Fruit Experiment Station," Kent.	
A2.	,, ,, 1921. In 1917, 18, 19.	Reports became fuller and were incorporated with those of the Research and Advisory Department, S.E.A. College, Wye, Kent.	
A3.	,, ,, 1922. In 1920, 21.	After incorporation as an independent Research Institute reports were printed in the Journal of Kent Farmers' Union (December, 1920 to February, 1922).	
A4.	,, ,, 1923. In 1922, 23, 24.	The Annual Report took the present form of independent publications. That for 1922 is now out of print. The 1923 Volume is still obtainable, price 3s. 4d.	
A5.	,, ,, 1924.	East Malling Research Station.	Price 5s., postage 6d.
*A6.	,, ,, 1925.	East Malling Research Station.	Price 2s. 3d.., postage 4d.
	Popular Articles Contributed to Various Journals.		
H3.	Progress in Methods of Practical Fruit Growing. By R. G. Hatton.	Journal of Royal Agricultural Society of England, Vol. 82, pp. 49-117, 1921.	To be obtained only from Publishers, John Murray, Albemarle St., London.
H4.	Fruit Growing in Small Gardens. By R. G. Hatton.	The Garden, Vol. lxxxviii., Nos. 2727, 2728, 2729, 2730, 2731. February to March, 1924.	
H5.	The Control of the Fruit Tree Through its Roots. By R. G. Hatton.	" Country Life," Vol. lv., No. 1430, pp. 867-869, June, 1924.	
H6.	Pruning Neglected Fruit Trees. By N. H. Grubb and A. W. Witt.	The Garden, Vol. lxxxviii., No. 2726, pp. 88-89, 16th February, 1924.	
H7.	" Notes to Fruit Growers."	Contributed monthly to Journal of the Kent Farmers' Union.	